

The University of Chicago

STANDARDS FOR SCHOOL PLANT
CONSTRUCTION ESTABLISHED
BY STATE REQUIREMENTS

A DISSERTATION SUBMITTED TO THE FACULTY
OF THE DIVISION OF THE SOCIAL SCIENCES
IN CANDIDACY FOR THE DEGREE OF DOCTOR OF
PHILOSOPHY

DEPARTMENT OF EDUCATION
AUGUST, 1946

By
MILTON WRIGHT BROWN

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CHAPTER I

INTRODUCTION

The Problem and Purposes of the Study

The purpose of this investigation is threefold. The first purpose is to discover the requirements established by different states for materials and methods in the erection and alteration of school buildings, and to ascertain the legal provisions relating to school sites, and to determine whether the requirements establish standards for construction that are relatively uniform or widely varying among these states. Some of these requirements are enacted in state statutes. Others are embodied in rules and regulations of state agencies which though made with delegated authority have the effect of laws. A tabulation of the existing requirements shows which factors of planning and construction are most frequently subject to state regulation while an analysis and comparison of the requirements reveals whether the requirements establish standards that are relatively uniform or widely varying.

The second purpose is to discover whether standards established by state requirements conform to desirable and generally accepted standards used in the evaluation of school buildings and in schoolhouse planning. It is of both interest and of importance to know whether state requirements establish standards substantially equal to desirable and generally accepted standards. Do the several states lag or do they pioneer in implementing desirable and continually improving standards of both educational and structural character? In order to answer this question a comparison of the state requirements is made with recommended requirements which are regarded as desirable and which are commonly used in the planning and evaluation of school buildings. Five such statements of standards have been published, namely:

1. Standards for Elementary School Buildings by Strayer and Engelhardt.
2. Standards for High School Buildings by Strayer and Engelhardt.

3. Standards for Junior High School Buildings by Engelhardt.
4. Standards for the Evaluation of School Buildings by Holy and Arnold.
5. Recommendations of the National Council on Schoolhouse Construction.

The last publication mentioned is revised yearly through the Council's Committee on Standards which has drawn frequently from current codes of the following agencies:

- a. National Fire Protection Association; Boston, Massachusetts.
- b. National Board of Fire Underwriters; New York, New York.
- c. Underwriters Laboratories; Chicago, Illinois.
- d. National Bureau of Standards; Washington, D.C.
- e. American Society for Testing Materials; Philadelphia, Pennsylvania.
- f. American Standards Association; Washington, D.C.

The third purpose of the study is to determine if the newer codes are more complete and adequate than the older codes. It might reasonably be expected that the newer codes would be more complete and that they would establish standards exceeding those established by the older codes. It is also of interest to discover whether trends in certain aspects of schoolhouse construction may become evident as the requirements are studied in relationship to the dates of their adoption. Consequently a comparison and appraisal is made of the more recently adopted codes with the earlier ones.

Other Studies and Investigations in This Area

In 1925 the National Education Association published a report prepared by a special Committee on Schoolhouse Planning and Construction.¹ Chapter VII consists of a very brief discussion of state regulations in planning and construction. Included in this chapter are charts showing regulatory provisions for the several states in 1910, 1915, and 1920. While there was a rapid growth in state regulation during these years, it was pointed out that this movement was still in its infancy in 1920 and that regulations were very fragmentary, only one state having regulations covering fifty-eight items which this committee felt

¹Report of the Committee on Schoolhouse Planning and Construction. Washington, D.C.: National Education Association, 1925.

it should be concerned with, and only sixteen states having provisions covering as many as half of these items. No study of the specific standards of regulatory provisions for any of these items was made.

In 1929, Howard M. McGowan made a study entitled "An Analysis of State School Building Codes of the United States."¹ He states that his purpose was "to present a complete picture of the statutory requirements made by the several states in respect to the construction and sale of school buildings, and legal provisions regarding site."² While this investigation was interesting and possessed considerable value at the time, it also had the following conspicuous limitations.

In the first place, there existed regulatory provisions that were not statutory, such as administrative regulations of agencies exercising delegated powers. Frequently, agencies other than the State Department of Education exercise such delegated powers, and formulate rules and regulations. A study of all such rules and regulations must be made in a complete or comprehensive investigation.

A second limitation is found in the fact that many states do not have special state codes for schoolhouse construction. The absence of a special code does not necessarily imply that there is no regulation. In such cases, provisions of the general codes applying to construction of all public buildings must be studied, such as fire codes, safety codes, sanitation codes, etc.

The third limitation consisted in the failure to make a specific comparison of state standards with any statement of commonly accepted standards. At that time the Strayer, Engelhardt Standards for both Elementary and High Schools were available in addition to the Stevenson Score Card for Elementary School Buildings. The author did compare the various items for which there were some statutory provisions with the items included on the Stevenson Score Card for Elementary School Buildings. However, a comparison of the specific standards or specifications indicated for these items was not made.

¹Howard M. McGowan, An Analysis of State School Building Codes of the United States. Columbus, Ohio: Ohio State University, 1929. Unpublished.

²Ibid., p. 2.

It should also be pointed out that this study was completed fifteen years ago, and a study of the literature since 1929 indicates that frequent enactments of state regulatory measures have continued to date.

A study of building codes in one hundred American cities was made by John W. Sahlstrom in 1933.¹ This investigation was limited to factors that influenced safety, cost of construction and the educational efficiency of the school building. Of significance to the proposed problem is the fact that he reported that in 1931 a total of five hundred cities with a population of over five thousand had no local building ordinances. In light of the above fact he reached the following conclusion. "It is within reason, and in harmony with the best interests of education, to propose that the state code, which possesses the necessary powers to regulate all phases of construction, be constituted the sole legal control over local school building operations."²

A study entitled "School Plant Requirements for Standardized Elementary and Accredited High Schools" was made by Haskell Pruett in 1934.³ It is at once apparent that the standards suggested in the study are not requirements that can be enforced in schoolhouse construction. Neither are they specific, using instead such qualifying adjectives as adequate, good, poor, etc. He concludes that, due to the overlapping of functions and duties in the various state departments, there should be established in each State Department of Public Instruction a Division of School Plant. He suggests that in this Division should be placed the responsibilities of preparing a state building code and executing the rules and regulations of the state fire marshall and the state health commissions.

What seems to be the most recent and complete of the studies in this general area is that of Charles Sohl.⁴ He

¹John W. Sahlstrom, Some Code Controls of School Building Construction in American Cities. New York: Bureau of Publications. Teachers College, Columbia University, 1933.

²Ibid., p. 18.

³Haskell Pruett, School Plant Requirements for Standardized Elementary and Accredited High Schools. Nashville, Tenn.: George Peabody College for Teachers, 1934.

⁴Charles Edwin Sohl, State Control of the Planning and Erection of Public School Buildings. Philadelphia, Penn.: University of Pennsylvania, 1935.

studied the agencies, nature, and extent of state control involved in the location, planning, and erection of school buildings in the forty-eight states, as this control relates to sites, plans and specifications, bids, contracts, contractors, bonds, mechanics liens, and the status of the architect. He reported a total of seventeen agencies controlling some phase of the construction program, frequently several agencies sharing control in a single state. He also reported that this control was exercised in relationship to thirty-nine items or aspects of school-house construction. At least twenty-three of these are details of construction for which minimum standards have been specified. While he pointed out that minimum requirements are established for these items, he made no attempt to study these requirements.

In addition to statutory control, he reported two other types of regulatory control, namely that exercised:

1. By some state agency or agencies of all building plans and specifications.
2. By some state agency or agencies of certain specific features of building plans or specifications.

After an examination of a large number of court decisions, he summarized their import with the following statement: "The courts have emphatically upheld the enforcement of such rules and regulations when there has been statutory authority granting this power to a state agency."¹

This conclusion indicates the necessity of analyzing not only statutory enactments but the rules and regulations of all state agencies exercising any measure of control.

Sources of Data

Data for the present study were collected from the following sources:

1. Legislative enactments pertaining to the erection of school buildings in each of the states.
2. Rules and regulations of state agencies relating to the erection of school buildings which, through delegated authority, have the effect of statutory enactment.
3. The statements of school building standards used in evaluating school buildings.
4. Codes and specifications adopted and recommended by the six agencies relating to specific structural and equipment standards. The agencies are listed on page 2.

¹Ibid., p. 74.

The Methods Employed in the Study

It is evident that certain methods must be adopted and followed in detail, both for securing the facts and for presenting them. The first step consisted in securing copies of codes and regulations in effect in the several states. A letter was addressed to the State Department of Education or Public Instruction in each of the forty-eight states requesting a copy of their latest building code or regulations governing schoolhouse construction. It was further requested that in instances where requirements were not assembled in a single code and the State Department of Education could not supply them, that other state agencies be indicated which could provide them.

In every instance either replies or copies of statutes and regulations were sent. Where the information was incomplete or not entirely clear, further correspondence was employed until the points in question were made clear. In every instance where agencies other than the State Department of Education exercise any regulatory control, a letter similar to the one sent to the Department of Education was sent to each agency. In each case, replies were received. Where information was not complete or entirely clear, further follow-up by means of correspondence was again employed. The author received splendid cooperation and helpful assistance from each source contacted.

In securing the facts the method of analysis is necessarily used most extensively. The regulations in effect, whether statutory or otherwise, are of necessity largely descriptive and an analysis of each was required in order to arrive at comparable aspects or elements.

In presenting the facts, three methods have been employed.

1. Descriptive analysis.--This was necessitated because, as pointed out above, the materials collected are almost entirely descriptive.

2. Comparison.--In determining the number of states with minimum requirements regulating particular aspects or details of construction a quantitative method is necessary. Where comparisons of various standards can be made quantitatively this is done. A tabular method of presentation is employed wherever it was found practicable. Where such tabular presentation was found to be impractical, descriptive comparison is resorted to.

3. Reference.--In the interpretation of the facts and in

formulating conclusions concerning the adequacy of the standards in effect, it becomes apparent that some point of reference is necessary. In attempting to determine whether state requirements establish desirable and generally adequate standards the latest published recommendations of the National Council on Schoolhouse Construction were employed in this study. This decision was based on several reasons. In the first place, the other published standards are not as recent as those of the National Council. Furthermore, the National Council on Schoolhouse Construction is composed of individuals representative of several interests and responsibilities in school building construction, architects, bureaus of construction in city school systems, and some thirty representatives of state departments of education. Of this latter group, the majority are identified with the established divisions of schoolhouse planning and construction. This latter group are usually charged with the responsibility of approving plans and specifications in their respective states.

The National Council describes itself and its purpose in the following two paragraphs.

The National Council on Schoolhouse Construction is a voluntary association of persons with a professional interest in bettering the physical conditions of school buildings. It has set down as one of its purposes "the establishment of reasonable standards for school buildings and equipment, with due regard for economy of expenditure, dignity of design, utility of space, healthful conditions, and safety of human life."

In carrying out this purpose it has, through its Committee on Standards, prepared a number of recommendations in regard to various conditions which affect the health and comfort of the pupils. It presents them herewith, as a contribution to what it proposes will cover eventually the various factors that enter into a proper understanding of the physical needs of a school and means whereby they may be achieved.¹

Furthermore, there is constant study and re-evaluation of the recommendations by the Committee on Standards in light of new information and research in this field. Thus the recommendations are subject to yearly revision or change.

In addition the National Council utilizes standards established by the National Fire Protection Association, the Na-

¹Proceedings of the Nineteenth Annual Meeting of the National Council on Schoolhouse Construction, 1941, p. 30. Nashville, Tennessee: George Peabody College, 1942.

tional Board of Fire Underwriters, the National Bureau of Standards and the American Standards Association. Liaison Committees are maintained with two of the above associations.

Because of the personnel of the National Council on Schoolhouse Construction and its procedures, it is believed that their published recommendations constitute the most valid statement of standards available. Therefore, only this statement of standards was employed in checking the adequacy of state requirements.

All of the minimum requirements in effect in the several states were checked against these statements of standards. Where the requirements in effect substantially meet the National Council's recommendations, it is so indicated in the tabulations in each chapter. Where any minimum requirement seems to vary from the recommendation of the National Council to any significant degree, the essential provisions of the state requirement are briefed so that a comparison can be made. Where quantitative standards of measurement are employed, the figures are included in every instance.

The Scope and Limitations of the Study

Regulatory measures, both statutory and those adopted by other agencies delegated this authority, for all but one of the thirty-five states which have them in force were canvassed. Thirteen states reported that they had no minimum standards required by state regulations. It was impossible to secure a copy of the Minnesota requirements. An accounting of the material collected is found in the bibliography. Following are lists of states grouped according to statutory requirements and requirements established by state agencies. In each instance, the agency or agencies establishing the standards are listed. A few states have requirements of both kinds. In all such instances, this is indicated by an asterisk.

Standards have been established by statutory enactment in the following states:

Arizona	*Michigan	Oklahoma
*Colorado	Missouri	*Pennsylvania
*Connecticut	*Montana	South Carolina
Florida	Nebraska	South Dakota
Indiana	New Mexico	Texas
Kansas	North Dakota	*Virginia

Standards have been established in the following states
by state agencies:

Alabama	State Superintendent
Arkansas	State Department
California	Division of Architecture, Department of Public Works
*Colorado	Industrial Commission
*Connecticut	State Board of Education--State Fire Commission if motion picture film will be used
Delaware	State Board of Education
Idaho	State Board of Education
Illinois	Department of Public Safety, Division of Fire Prevention
Kentucky	State Board of Education
Maine	State Commission of Education and State Bureau of Health
Maryland	State Superintendent
Massachusetts	Department of Public Safety
*Michigan	Department of Health
*Montana	State Board of Health
New Jersey	State Board of Education
New York	Commission of Education
Ohio	Division of Factory and Building Inspection, Department of Industrial Relations
*Pennsylvania	State Council of Education Department of Public Instruction Department of Labor and Industry Department of Health
Vermont	State Fire Marshall Department of Public Health
*Virginia	State Board of Education
West Virginia	State Board of Education
Wisconsin	Industrial Commission

The Division of Architecture in California stipulates the use of the Uniform Building Code of the Pacific Coast Building

Officials Conference for safety requirements and standards.

Several limitations which are inherent in this study should be pointed out.

In the first place, it is limited to certain aspects or factors which are commonly the subject of requirements in the states. Only a very few states have minimum requirements concerning any of several special educational features such as administrative offices, laboratories, gymnasiums, kindergartens, music rooms, art rooms, and equipment. No state with the one exception, namely Connecticut, has regulations concerning all of these features. It therefore seemed desirable to omit these items and to include only the following twelve large items or aspects of planning and construction more commonly the subject of regulation.

1. School Grounds
2. Playgrounds and Athletic Fields
3. General Construction
4. Corridors
5. Stairways
6. Exits
7. Sanitary Facilities
 - a. Toilet Rooms and Fixtures
 - b. Drinking Fountains
 - c. Service Sinks
 - d. Showers
8. Service Systems
 - a. Water Supply
 - b. Heating
 - c. Ventilating
 - d. Electric Service
 - e. Service Rooms
9. Fenestration
10. Artificial Illumination
11. Classrooms
12. Auditoriums

In the second place, specifications concerning kinds and qualities of materials and detailed construction procedures such as proper mix for mortars, methods of laying masonry work, size of joists, sills and other construction members, and live bearing load limitations are not included. Only a few states have minimum requirements or specifications relating to any of these items. In almost every instance where found, they are applicable

to standard construction of one-room buildings where no architect is to be employed and standard plans are provided by some agency of the state. Such specifications are concerned almost entirely with specific directions for the contractor and have little if any effect on the over-all planning of the building.

Finally, it is impossible to claim absolute accuracy in cataloging and tabulating the requirements found. The question of interpretation is involved in each requirement. The regulations are of necessity largely descriptive. Phraseology frequently varies quite widely in the several regulations relating to the same specific item. On the other hand, the requirements and specifications may vary only in detail, and it becomes necessary to decide whether the detail is significant in determining the standard or whether the requirement is substantially the same as another. In a number of instances, the phrase "as possible," is employed. In such cases it is impossible to determine what latitude might be allowable by the approving agency.

At best, an analysis of the kind necessary in this study can be only relatively correct. While the author has studied both the recommendations of the National Council on Schoolhouse Construction and the state regulations in a careful and painstaking manner, re-reading many of them several times, and analyzing them for significant details, he fully realizes that his interpretation in some instances might be in error or might vary from that arrived at by another person. In cases involving numbers, whether in terms of percentage or degree, no question of interpretation is involved. It is apparent that the terms "fire proof" and "fire resistant" are loosely used and in all probability are used interchangeably. Where specifications for such construction follow the term employed, the author has attempted to make his interpretation in light of the standards found in the Building Code of the National Board of Fire Underwriters.

CHAPTER II

SCHOOL GROUNDS, PLAYGROUNDS AND ATHLETIC FIELDS

School Grounds

The National Council on Schoolhouse Construction has formulated a list of twelve recommendations relating to the area, location, and equipment of schoolgrounds. Seventeen states have regulations relating to one or more of these recommended standards. No state has requirements relating to all twelve of these items, the most complete codes being Connecticut and Pennsylvania embracing all but two and three of the items, respectively.

Table 1 shows the states having minimum requirements corresponding to the recommendations of the National Council on Schoolhouse Construction.

Table 1 reveals at least two interesting facts. In the first place, it is disappointing that so few states have any minimum requirements relating to the area, location, and equipment of school sites and grounds, inasmuch as such requirements are highly important to pupils, the population of the districts served, and certain aspects of the school program. Requirements concerning the area and location of the site are more frequent than those concerning details of equipment. This is no doubt as it should be. However, it is unfortunate that so frequently no distinction in the requirements is made between elementary-school and high-school sites.

In the second place, the largest number of requirements are directed at providing a safe and sanitary environment for the school and pupils. It is commendable that such concern is evidenced.

Each recommended standard of the National Council is reproduced below. Immediately following are listed those states with requirements of a similar kind. In all instances where the state requirement is substantially the same as the recommendation of the National Council, it is indicated by the term "same." Where there is a variation of any significant difference, the es-

TABLE 1

STATES HAVING REQUIREMENTS CONCERNING SCHOOL GROUNDS CORRESPONDING TO
THE RECOMMENDATIONS OF THE NATIONAL COUNCIL

Recommendations of the National Council*													
States	Area			Location					Equipment				Total
	1	2	3	4	5	6	7	8	9	10	11	12	
Connecticut.....	x		x	x	x	x	x	x	x		x		10
Delaware.....	x	.	.	.	x	x	x	x	x				6
Florida.....	x	.	.	.	x	x	x	x	x				6
Indiana.....		.	.	.	.	.	x	x	x				2
Kentucky.....	x	x			.	.	x	x	x				6
Maine.....		.	.	.	.	.	x	x	x				2
Maryland.....	x	x			x	x	x	x	x				7
Michigan.....	x				.	.	.	.	.	x			3
Montana.....	x				.	x	x	.	x				4
New Mexico.....		.	.	.	.	.	x	.	x				1
New York.....		.	.	.	x	x	x	.	x				3
North Dakota.....	x		.	.	.	.	.	.	.				1
Ohio.....		.	.	.	.	.	.	.	.				1
Pennsylvania.....	x	x	x	x	.	x	x	x	x		x		9
South Dakota.....		.	.	.	.	.	.	.	.	x	x		2
Vermont.....		.	.	.	.	.	x	.	x				2
Virginia.....	x	x	.	.	.	.	.	.	.				2
Total.....	10	5	2	2	5	8	11	7	12	2	3	0	..

*1. Area of elementary sites, p. 14; 2. area of high school sites, p. 14; 3. areas for physical education and athletics, etc., p. 14; 4. area for automobile parking, p. 14; 5. selected in light of a survey, pp. 14-15; 6. accessible and near school population center, p. 15; 7. removed from railroad and areas of heavy traffic, p. 15; 8. proper orientation of building and economical use of space, pp. 15-16; 9. proper drainage and free from sanitary hazards, p. 16; 10. adequate and safe fencing, p. 16; 11. substantial steel flagpole, p. 16; 12. sill cocks or hose hydrants be installed, p. 16.

sential provisions of the requirement are listed in brief form.

Area

1. Elementary sites should range from 5 to 10 acres.
 1. Connecticut--3 acres and up depending on enrollment.
 2. Delaware--2 acres plus 250 sq. ft. for each pupil with a maximum of 10 acres.
 3. Florida--2 acres plus 1 additional acre for each 50 pupils after the first 50 up to a total of 500 pupils.
 4. Kentucky--3 acres.
 5. Maryland--3 acres.
 6. Michigan--1,000 sq. ft. per pupil with a minimum of 25,000 sq. ft.
 7. Montana--1 acre or 1/2 of an average city block.
 8. North Dakota--1 to 5 acres.
 9. Pennsylvania--5 acres in urban districts.
 10. Virginia--272 sq. ft. per pupil based on ultimate capacity of the building. Apparently applies to high school site, also.
2. High School sites from 10 to 30 acres.
 1. Connecticut--7 acres and up depending on enrollment.
 2. Kentucky--10 acres.
 3. Maryland--5 acres.
 4. Pennsylvania--8 to 25 acres.
3. That the site include areas adequate to provide for accepted programs of physical education, athletic field, and recreation for the needs of the school and community.
 1. Connecticut--Same.
 2. Pennsylvania--Same.
4. That it include space for the safe parking of automobiles.
 1. Connecticut--Same.
 2. Pennsylvania--Same.
5. That the site be selected only in light of a comprehensive educational and physical survey, thereby basing the selection on principles rather than price.
 1. Connecticut--Same.
 2. Delaware--Same.
 3. Florida--Same.

4. Maryland--Same.

5. New York--Same.

6. That the site be readily accessible to all concerned and unusual travel distances minimized and that it be near the school population center it is ultimately to serve.

1. Connecticut--In fully developed areas maximum travelling distances as follows:
 Elementary districts-- $3/4$ mile.
 Junior high districts-- $1\frac{1}{2}$ miles.
 Senior high districts--2 miles.
2. Delaware--Same.
3. Florida--Same.
4. Kentucky--Same.
5. Maryland--Same.
6. Montana--Same.
7. New York--Same.
8. Pennsylvania--Elementary districts-- $3/4$ mile.
 Junior high districts-- $1\frac{1}{2}$ miles.
 Senior high districts--2 miles.

7. That the site be located so as to be removed from such objectionable features as noise, odors, dust, railroads, main or heavily travelled highways or streets or areas of dense traffic.

1. Connecticut--Same.
2. Delaware--Same.
3. Florida--Same.
4. Indiana--Not less than 500 ft. from any railroad.
5. Kentucky--Same.
6. Maine--Same.
7. Maryland--Same.
8. Montana--Same.
9. New Mexico--Same with the additional requirement of at least 400 ft. from any main artery of travel.
10. Pennsylvania--Same.
11. Vermont--Same.

8. That the site have such physical characteristics as to permit proper architectural setting, orientation and landscaping as well as an economical use of the space as a whole.

1. Connecticut--Same. Also the building be not less than 100 ft. from the street.
2. Delaware--Same. Also the building not to occupy more than 20 per cent of the site.

3. Florida--Same.
4. Kentucky--Same. Also the long axis of the building be north and south.
5. Maryland--Same. Also no driveway to encircle building.
6. Ohio--Building area not more than 75 per cent of a corner site or 70 per cent of an interior site.
7. Pennsylvania--Same. Building must be 30 ft. from the lot line or any other building.

9. That the site be free from any sanitary hazards, be properly drained, and not adjacent to areas which may give rise to insanitary conditions.

1. Connecticut--Same.
2. Delaware--Same.
3. Florida--Same.
4. Indiana--Same.
5. Kentucky--Same.
6. Maine--Same.
7. Maryland--Same.
8. Michigan--properly drained.
9. Montana--Same.
10. New York--Same.
11. Pennsylvania--Same.
12. Virginia--Same.

Equipment

10. That proper fencing be provided where required to afford protection to children or to property.

1. Michigan--Same.
2. South Dakota--Where stock is permitted to roam.

11. That a substantial steel flagpole be erected on the grounds where it may show to the best advantage.

1. Connecticut--Steel pole not specified.
2. Pennsylvania--Steel pole not specified.
3. South Dakota--Steel pole not specified.

12. That an adequate number of sill cocks or hose hydrants be installed.

No state requirements.

Rather wide variations in the size of sites required may be noted. This may be explained by the fact that in some in-

stances the requirements apparently encompass all kinds of schools from the one-room rural school to the large urban school located in fully developed and congested areas. The difficulty of making any blanket requirement fit all of these situations is apparent. The fact that the area requirements in general are somewhat more meager than the recommendations of the National Council may be due to the above fact and the additional fact that the recommendations of the National Council seem to have been developed for larger schools rather than the small rural school.

Playgrounds and Athletic Fields

A separate list of six recommendations relating to playgrounds and athletic fields has been adopted by the National Council on Schoolhouse Construction. This separation from school grounds is somewhat confusing in view of the fact that the playground, athletic field, and recreational areas are usually a part of the schoolground. It is apparent that they are usually so considered in the state requirements. Only six states make specific mention of special playgrounds or athletic fields. Of these six, only four make a clear distinction between the schoolgrounds and the playground and athletic field. It is evident that in the other cases the playground and athletic field are considered a part of the site, and the requirements in force relating to schoolgrounds are considered sufficient. Following are the recommendations of the National Council and the states with requirements similar to the recommendations.

1. That such athletic field be located preferably adjacent or as part of the school site.

1. Connecticut--Same.
2. Pennsylvania--Same.
3. Vermont--Same.
4. Virginia--Same.

Grading, Draining, and Surfacing

2. That playgrounds and athletic fields be so graded, surfaced, and supplied with surface and sub-surface draining as to permit maximum utilization.

1. Connecticut--Same.
2. Maryland--Same.
3. Michigan--Same.

4. Pennsylvania--Same.

5. Virginia--Same.

Equipment

3. That if fixed playground equipment is provided, it be safe and substantial and placed on substantial foundations, including those for bleachers, tennis court fencing, and other necessary permanent equipment.

No state requirements.

4. That adequate drinking fountains be installed, readily accessible from the play space.

1. Connecticut--Same.

5. That an adequate number of hose hydrants be installed where required for watering and cleaning purposes.

No state requirements.

6. That readily available toilet facilities and storage space for playground equipment and maintenance tools be provided.

1. Connecticut--Same.

2. Virginia--Toilet facilities only.

Connecticut, with four, is the only state with requirements relating to more than two of these six recommendations.

The above tabulation shows that few states have considered the provision and improvement of playgrounds and athletic fields a proper or necessary factor for minimum requirements. Table 1 shows only two states, namely, Connecticut and Pennsylvania, requiring areas adequate for accepted programs of physical education, athletic field, and recreation needs of the school and community. While this is desirable, it may be that the assumption prevails that such will be done without specific requirements. It is probably more likely that attention to other more urgent factors in schoolhouse construction, such as those concerning safety and sanitation, have been given prior attention.

Summary

It was noted previously that wide variation in the minimum area requirements existed and that as a general rule the area requirements were somewhat smaller than those recommended by the National Council on Schoolhouse Construction.

It is likely that no fixed rule can or should be made as to area of school sites in view of the wide range of variables to be considered such as the area and population to be ultimately served by the building, density of population, land values and possibly others. This may explain the fact that so few states have enacted requirements of this kind. It may be noted that only four states have separate requirements concerning high-school sites. Even with this limited number having requirements relating to high-school sites the minimum areas required vary from five to ten acres.

Specific requirements concerned with the location of the site, especially in its relation to safety and sanitary hazards, while somewhat more frequent, are yet far from common. Inasmuch as there can be no disagreement regarding locating of sites remote from safety and sanitary hazards, there appears to be a real need for the enactment of such requirements where they are lacking.

Only four states have requirements concerning equipment. It would seem that proper fencing to afford protection to children should be a universal requirement. Aside from a requirement of this latter kind, it is doubtful if requirements prescribing minimums for equipment could or would serve a useful purpose due to the great number of variables inherent in the situation.

Aside from minimum requirements affecting safety and sanitation which should be universal and specific, it is clear that all requirements must be quite general in nature in order to apply reasonably to the extreme variations which exist.

Very few states have requirements relating to playgrounds and athletic fields. The tabulation in this chapter together with Table 1 show that with possibly only two exceptions, namely Connecticut and Pennsylvania, codes are at best fragmentary and incomplete. There is apparent need for more states to establish minimum requirements, and also for more complete coverage on the part of almost all states of the more important aspects involved in the selection and improvement of school sites, playgrounds, and athletic fields. However, it is evident that such requirements must permit sufficient flexibility to provide for the many variables encountered in different situations. Requirements concerning size and location within the district to be served must of necessity be very general in their nature.

CHAPTER III

FIRE RESISTING REQUIREMENTS FOR GENERAL CONSTRUCTION

Fourteen recommendations are made by the National Council concerning general construction of schoolhouses. All of these recommendations are specifically designed to provide for the safety of occupants in case of fire. Standards for materials and construction are established by these recommendations for several items or aspects of building construction for buildings of varying heights or stories. These standards are accepted by the Council as adequate to insure reasonable safety from fire hazards.

In order to avoid misunderstanding and to clarify the recommendations, they are preceded by two definitions or stipulations. The first of these relates to the basement or ground floor, and reads as follows: "For the purpose of these standards the Council considers a basement or ground floor as a story if the ceiling is seven and one-half feet or more above the grade level at any point next to the building."

Few states have definitions of this kind, and it is impossible to determine with certainty whether or not the basement is to be counted as a story in some instances. Where such definitions are lacking, it is probably safe to assume that the basement or ground floor, if containing heater and fuel rooms, is not to be counted as a story.

Connecticut specifies that the basement or ground floor shall be counted as a story if the ceiling is six feet or more above grade level next to the building for a horizontal distance of one hundred feet.

Maryland defines a basement as a story if it is used for any purpose other than heating plant and fuel storage.

Michigan specifies that the basement shall be considered a story.

New York specifies a ceiling height of seven and one-half feet or more above grade before the basement shall be considered a story.

Ohio classifies the basement as a story whenever the main

first floor line is eight feet or more above the grade line.

Pennsylvania stipulates that a basement or ground floor be counted as a story if the floor level of the above story is more than five feet above ground or curb level.

Wisconsin classifies a basement as a story if the basement ceiling is more than five feet above grade.

The need for similar definitions on the part of each state with requirements concerning height of buildings is obvious.

The second definition or stipulation relates to the fire rating of materials used in construction and reads as follows:

"The fire rating of materials is to be based upon specifications of the American Society for Testing Materials for fire tests and performance report of the National Bureau of Standards, National Board of Fire Underwriters and other accepted testing laboratories."

Only Connecticut has a similar specification. It is likely that in all instances it is assumed that the fire rating of materials shall be based on the specifications of the American Society for Testing Materials inasmuch as these specifications are almost universally accepted and employed as standards by architects.

Table 2 shows states having requirements corresponding to each of the fourteen recommendations of the National Council concerning general construction. However, the standards established in the requirements in some instances are not equal to the standard established by the recommendations of the National Council.

It might reasonably be expected that more states would have requirements establishing minimum standards for general construction than for any other aspect of schoolhouse construction. This is particularly true since the fire resistance rating, which is dependent on the type of construction, is without doubt the most important single factor in building safety. It is both surprising and disappointing to find that only fifteen states of a total of forty-seven have minimum requirements for one-story buildings, sixteen for two-story buildings, and eleven for buildings of three or more stories. In the states where no requirements exist, the responsibility for safety rests with the building architect or those responsible for local building codes. Inasmuch as local building codes are not common, and those directly

TABLE 2
STATES HAVING REQUIREMENTS CONCERNING FIRE RESISTING CONSTRUCTION CORRESPONDING
TO THE RECOMMENDATIONS OF THE NATIONAL COUNCIL

States	Recommendations of the National Council by Number*													Total	
	1-Story Bldgs.	2-Story Bldgs.				3- to 6-Story Bldgs.	Bldgs. Higher than 6 Stories	Stair Enclosures or Fire Towers				Chimneys			
	1	2	3	4	5	6	7	8	9	10	11	12	13		14
Alabama.....	x	x	.	.	x	.	.	.	.	.	.	.	.	.	3
California.....	x	x	x	.	x	.	.	.	.	.	.	.	.	.	11
Connecticut.....	x	x	x	.	x	.	.	.	.	.	.	.	.	.	8
Delaware.....	x	x	.	.	x	.	.	.	.	.	.	.	.	.	5
Florida.....	x	x	.	.	x	.	.	.	.	.	.	.	.	.	4
Idaho.....	x	x	.	.	x	.	.	.	.	.	.	.	.	.	6
Illinois.....	.	x	.	.	x	.	.	.	.	.	.	.	.	.	4
Kentucky.....	.	x	.	.	x	.	.	.	.	.	.	.	.	.	4
Maryland.....	x	x	.	.	x	.	.	.	.	.	.	.	.	.	3
Massachusetts.....	.	x	.	.	x	.	.	.	.	.	.	.	.	.	9
Michigan.....	x	x	.	.	x	.	.	.	.	.	.	.	.	.	1
New Jersey.....	.	x	x	.	x	.	.	.	.	.	.	.	.	.	6
New York.....	.	x	.	.	x	.	.	.	.	.	.	.	.	.	1
Ohio.....	.	x	.	.	x	.	.	.	.	.	.	.	.	.	7
Pennsylvania.....	x	x	.	.	x	.	.	.	.	.	.	.	.	.	9
South Carolina.....	x	x	.	.	x	.	.	.	.	.	.	.	.	.	6
Virginia.....	x	x	.	.	.	.	.	.	.	.	.	.	.	.	4
West Virginia.....	x	x	.	.	.	.	.	.	.	.	.	.	.	.	3
Wisconsin.....	x	x	.	.	.	.	.	.	.	.	.	.	.	.	3
Total.....	15	16	6	0	18	11	0	6	9	4	8	5	8	10	..

*1. Specifications for one-story buildings (p. 23); 2. General specifications for two-story buildings (p. 25); 3. Roof coverings (p. 27); 4. Specifications for rooms located under corridors, stairways, etc. (p. 27); 5. Heater and fuel rooms (pp. 27-28); 6. Specifications for three- to six-story buildings (pp. 29-30); 7. Specifications for buildings higher than six stories (p. 32); 8. Fire towers in less than semi-fireproof two-story buildings (p. 32); 9. Required in more than two-story buildings (p. 33); 10. Conformity to "Underwriters' Code" (p. 34); 11. Partitions and doors between corridors and stairhall (p. 34); 12. Special devices if doors are normally open (p. 35); 13. Construction materials for chimneys (p. 35); 14. Chimney lining (p. 35).

relating to schoolhouse construction are even more infrequent, the need for adequate regulation is accentuated. Twenty-eight states have no requirements concerning general construction; nineteen states have minimum requirements corresponding to one or more of the fourteen recommendations. Reading of the table shows that only nine states have requirements corresponding to more than five of these recommendations, and that only six states have requirements corresponding to as many as fifty per cent of the fourteen recommendations. California with eleven heads this list, followed by Wisconsin with ten, Pennsylvania and Maryland with nine each, Connecticut with eight, and Ohio with seven.

It is apparent that a great lag exists between good practice and the widespread enactment of requirements establishing such practice.

The following tabulations show comparisons of state requirements with the recommendations of the National Council on Schoolhouse Construction.

Fire Resisting Requirements for One-Story Buildings

The National Council makes the following recommendation for one-story buildings.

1. That one-story buildings may be constructed of any type of material without regard to the fire rating of such material, except that heater and fuel rooms be enclosed with construction having a one-hour rating.

The following fifteen states have requirements or provisions relating to the type of construction permitted in one-story buildings.

1. Alabama--same. Fire resistive materials for heater and fuel room construction. No fire rating prescribed. Approved fire-doors to heater room entrance if it opens to rest of basement.
2. California--same. If liquid or solid fuel is burned, a fire rating of three-hours. If gas, a fire rating of one-hour. Self-closing fire doors with one-hour rating.
3. Connecticut--same. In addition, partitions separating gymnasiums or auditoriums from the rest of the building and proscenium wall must have at least a one-hour rating.
4. Delaware--same. Heater, fuel and ventilating rooms must have fire-proof walls and concrete ceiling. Self-closing fire doors required.

5. Florida--same in all respects.
6. Idaho--same. Heating plant surrounded with fire resisting materials.
7. Kentucky--same except that fire rating for heater and fuel room is not specified.
8. Maryland--same. Three-hour rating specified for heater and fuel room.
9. Michigan--same. Heater and fuel rooms shall not be located directly beneath any portion of the building. Fire resisting walls and self-closing doors required.
10. Ohio--same. Standard fireproof heater room enclosure with entrance from the outside only. The building must be located at least thirty feet from any other structure and from the lot line.
11. Pennsylvania--same except that the fire rating is not specified.
12. South Carolina--same, except fire resisting walls for heater and fuel room are not specified. Ceiling must be either metal lath and plaster or two thicknesses of asbestos paper and one thickness of sheet metal.
13. Virginia--any type of material if the building is of not more than four classrooms. Fire resistive materials for heater and fuel rooms with self-closing fire doors.
14. West Virginia--same except no requirements for heater and fuel rooms.
15. Wisconsin--same. Two-hour rating for heater and fuel rooms.

The tabulation shows that requirements and specifications for one-story buildings where they are in effect are substantially the same as those recommended by the National Council. While the fire rating of the construction for the heater and fuel storage rooms is seldom specified in terms of hours, it is evident that the construction specified is in almost every instance equal and frequently higher than that required for a one-hour rating. Maryland and Wisconsin specify a fire rating of three and two hours, respectively. California specifies a three-hour rating if solid or liquid fuels are used and one-hour if gas is used. The requirement of Michigan seems to exceed even these. Only one state, West Virginia, fails to require fire-resisting construction of any kind for the heater and fuel room. The requirement in effect in South Carolina, however, fails to provide construction equal to one-hour rating.

It is surprising to find that only fifteen states have minimum requirements of this kind.

Fire Resisting Requirements for Two-Story Buildings

The National Council has formulated a list of four recommendations relating to the Construction of two-story buildings.

2. That two-story buildings (and one-story buildings if basements are usable for any purpose other than heating plant and storage rooms) may be constructed with self-supporting exterior walls of masonry or other incombustible materials, and with interior framing partly or wholly of wood or other similar materials, all assembled to have fire resistance rating not less than the following: exterior and fire walls, corridors and stairs including structural support, two hours; other structural elements, one hour.

1. Alabama--same for walls and framing. Stairways only must be of fire resisting materials.
2. California--exterior walls of fire resistive construction. Structural frame not less than heavy timbers. Interior partitions of one-hour fire-resistive construction. Wood lath or wood furring is prohibited. Columns must have not less than three-hour protection and beams and girders not less than two-hour protection. Stair enclosures of at least two-hour fire rating.
3. Connecticut--same for walls and framing.
 - a. All bearing walls, isolated piers, columns, and wall supporting girders must have a three-hour rating.
 - b. Corridor floors and ceilings and heater room ceilings must have two and one-half hour rating.
 - c. Fire partitions (corridor, stairway, heater room, and auditorium stage) must have a fire rating of two hours.
 - d. Floors and ceilings other than corridor and heater room and proscenium walls must have a one-hour rating.
4. Delaware--same for walls and framing. Fire resistive corridors and stairways, but no fire rating specified.
5. Florida--same for walls and framing. Fire resistive corridors and stairways but no fire rating specified.
6. Idaho--a. If a two-story building without basement, masonry walls only are required.
 b. For two stories above basement, the requirement is the same as the recommendation for walls and framing. Fire resistive corridors and stairways but no fire rating specified.
7. Kentucky--same for walls and framing. Fire resistive corridors and stairways but no fire rating specified.
8. Maryland--same for walls and framing. Fire resistive corridors, corridor ceiling, stairs and stair ceilings but no fire rating specified.

9. Michigan--all walls, floors, partitions and roofs shall be constructed of fire-resisting materials such as stone, brick, tile, concrete, gypsum, steel or other fire-resisting material. All steel members shall be protected by at least three-fourths of an inch of fire resisting material. No wood lath or furring shall be used. Wood may be used for floors, trim, sash, door and window frames.
10. New Jersey--Applies only if more than four rooms are above first floor. Enclosing walls of hard brick, stone or concrete. Corridor walls and floors of fire-proof construction and fireproof enclosed stairs.
11. Ohio--composite construction is permitted. Walls must be of masonry. No further specifications are provided except that basement stairways shall be enclosed with either brick walls not less than nine inches thick, concrete walls six inches thick, or hollow tile walls ten inches thick and equipped with standard self-closing fire doors.
12. Pennsylvania--In first class districts the building shall be of fire-resistive construction in its walls, floors, ceilings, and stairways, but with wood or composition floor surface, wood doors and interior finish. In districts of the second, third, and fourth class frame or ordinary construction is permitted.
13. South Carolina--exterior masonry walls at least twelve inches in thickness.
14. Virginia--same for walls and framing.
 - a. All bearing walls, isolated piers, columns and wall supporting girders must have a four-hour rating.
 - b. Other walls, beams and girders, and floors, and roofs must have a three-hour rating.
 - c. Fire partitions must have a two-hour rating.
15. West Virginia--same for walls and framing. Fire-resistive corridors and stairways but no fire rating specified.
16. Wisconsin--same for walls and framing. Either corridors and stairways must have a two-hour rating, or the entire first story must be of two-hour rating.

A careful analysis of the tabulation shows that with few exceptions, the minimum requirements in these sixteen states establish standards that are either substantially equal to or higher than those set up in the recommendations of the National Council.

In South Carolina the requirement of only exterior walls of masonry does not measure up to the recommendations. In Alabama and Ohio specifications likewise do not appear to equal the recommendations of the National Council. The same is true in Pennsylvania for other than first-class districts.

The following six states have minimum requirements that clearly exceed the recommendation: 1. Connecticut, 2. California, 3. Michigan, 4. Virginia, 5. New Jersey, 6. Wisconsin.

The following seven states have requirements that are substantially the same as the recommendations although the fire rating of corridors and stairways is not specified in terms of hours. 1. Delaware, 2. Florida, 3. Idaho, 4. Kentucky, 5. Maryland, 6. Pennsylvania (in first class districts), 7. West Virginia.

It should be noted that descriptions and definitions of fire resistance features of construction correspond in general to those contained in the Building Code recommended by the National Board of Fire Underwriters, and the classification of five types of construction set up by the American Institute of Architects.

3. That roof covering be fire-retardant and qualify as Class A or Class B under test specifications of Underwriters' Laboratory.

Only six states have requirements concerning type of roof covering to be used.

1. California--not less than class B.
2. Connecticut--Flat roof coverings to have a minimum service guarantee of twenty years.
3. Michigan--Roof shall be constructed of fire resisting material.
4. South Carolina--Covered with fire retarding material.
5. West Virginia--Slate asbestos and tile for high sloping roofs. Pitch and slag, asphalt or tile for flat roofs.
6. Wisconsin--not less than class B.

For some reason, little attention has been devoted to roof coverings in the several states.

4. That no rooms be located under a corridor, stairway, gymnasium, auditorium or assembly room (defined as a room having a capacity of 200 or more) unless such rooms be fully enclosed (walls, floor, and ceiling) by construction having a fire rating commensurate with the fire severity to be expected from the complete combustion of their contents.

No state has a requirement in effect of this kind.

5. That heater and fuel rooms be constructed of materials with not less than a semi-fireproof rating as defined by the "Underwriters Code," and doorways separating such enclosures from

other parts of the building be equipped with self-closing fire doors, and windows be wire glass in metal frames.

The Underwriters' Code referred to in this recommendation requires semi-fireproof construction to have "fire resistance ratings of not less than four hours for exterior non-bearing walls and for wall panels; not less than three hours for columns, and for wall supporting girders and trusses; not less than two hours for floors, for roofs, and for floor and roof supporting beams, girders and trusses; and in which exterior and interior bearing walls, if any, are of approved masonry or concrete."

This definition makes it clear that the minimum fire rating for any part of the heater and fuel room would be not less than two hours.

The following states have requirements specifying construction for the heater and fuel rooms. The specifications in abbreviated form are listed for each state.

1. Alabama--fire resistive construction with approved fire doors.
2. California--three-hour construction if solid or liquid fuel is burned. One-hour construction if gas is burned. Self-closing doors with one-hour rating.
3. Connecticut--two-hour construction with self-closing Kalamein doors.
4. Delaware--fireproof walls and concrete ceiling with self-closing fire doors.
5. Florida--fire resistive walls, ceiling and floor with self-closing fire doors.
6. Idaho--surrounded by fireproof material.
7. Illinois--eight inch masonry walls with ceiling of at least three-fourths inch of cement.
8. Kentucky--floors and walls of incombustible material with ceiling of at least three-fourths inch of cement plaster on metal lath. Approved fire doors.
9. Maryland--not less than three-hour construction with not less than two-ply tin clad self-closing fire door.
10. Massachusetts--masonry or fireproof walls with fireproof ceiling. Self-closing fireproof or automatic fire doors.
11. Michigan--walls of fire resisting material with automatically closing fire doors. Such units shall not be located directly beneath any portion of the building.
12. New Jersey--fireproof walls, floors and ceiling with Underwriters' approved type fire doors. Ceiling shall be reinforced concrete or standard fireproof

arched type and steel beam construction.

13. New York--fire walls and specially constructed fire-resisting ceilings.
14. Ohio--standard fireproof heater room with standard self-closing fire doors.
15. Pennsylvania--walls and ceiling of not less than one-inch cement or gypsum plaster on metal lath. At least double lap seamed tin clad doors.
16. South Carolina--ceiling of metal lath and plaster or two thicknesses of asbestos paper and one thickness of sheet metal.
17. Virginia--fire-resistive material for walls, ceiling and floors with self-closing fire doors.
18. Wisconsin--four-hour fire rating in all buildings more than one story.

Because of the brevity of many of the state requirements and the looseness with which the terms fireproof and fire resistive are used, it is impossible to determine with accuracy how the requirements compare or measure up with the recommendation. Greater specificity in the requirements would be needed to make careful and exact comparisons of the standards of construction described. However, it appears that the requirements in New York, Pennsylvania, South Carolina, and California, if gas is used as fuel, permit standards of construction considerably below those established by the recommendation. On the other hand, the standards in Connecticut, Maryland, Michigan, New Jersey, Wisconsin, and California, if solid or liquid fuel is used, appear to exceed those established by the recommendation. For the reasons previously mentioned, it is impossible to draw any conclusions or make comparisons for the following states: Alabama, Delaware, Florida, Idaho, Illinois, Kentucky, Massachusetts, Ohio, and Virginia.

Fire Resisting Requirements for Three- to Six-Story Buildings

Following is the recommendation of the National Council relating to the type of construction for buildings from three to six stories.

6. That three- to six-story buildings (and two-story buildings if basements are used or are usable for any purpose other than the heating plant) may be constructed with semi-fireproof construction as defined by the "Underwriters' Code." Wood

may be used for floors, trim, sash, doors, frames, etc. Areas having combustible contents exceeding thirty pounds per square foot of floor area to be provided with automatic sprinkler protection.

The Underwriters' Code defines semi-fireproof construction as follows:

"Structural members are of approved noncombustible construction having the necessary strength and stability and having fire resistance ratings of not less than four hours for exterior non-bearing walls and for wall panels; not less than three hours for columns, and for wall-supporting girders and trusses; not less than two hours for floors, for roofs, and for floor and roof supporting beams, girders and trusses; and in which exterior bearing walls and interior bearing walls, if any, are of approved masonry or reinforced concrete."¹

Eleven states have requirements establishing certain minimum requirements for buildings of three or more stories. However, the requirements in few instances constitute complete or adequate specifications when compared with the Underwriters' Code. Following are the specifications tabulated in brief form for each of the states having such minimum requirements.

1. California--Identical with the recommendation of the National Council with ratings the same as specified for semi-fireproof in the Underwriters' code.
2. Connecticut--structural members and bearing walls of 4 hour rating. Walls, all girders other than those specified above, beams, floors, ceilings and flat roofs, 2 1/2 hour construction. Fire partitions at least 2 hours.
3. Delaware--Buildings more than 2 stories above basement prohibited.
4. Florida--no building with combustible floors, roof, and finish shall be more than two stories.
5. Idaho--Masonry walls, fire-resistive corridors and stairways, but with ordinary construction otherwise.
6. Maryland--three-story buildings of fire resistive construction in walls, floors, stairs, and ceilings but with roof construction of wood. The roofing material shall be slate or slag. Interior finish may be of wood. Buildings of four or more stories apparently must meet the requirement of fireproof construction as defined by the Underwriters' Code.

¹National Board of Fire Underwriters. Building Code, p. 156. New York, 1943.

7. Michigan--no requirements beyond those applying to two-story buildings.
8. New Jersey--Fireproof construction. The doors, windows, window frames, roof rafters, and trusses, trim, finished floor, and other interior finish may be of wood.
9. Ohio--All buildings limited to three stories. Three-story buildings shall be of fireproof construction.
10. Pennsylvania--In first class districts the building shall be of fire resistive construction. In second, third, and fourth class districts all buildings of three and not more than four stories shall be of fire resistive construction in walls, floors, ceilings, and stairways but with wood or composition floor surface, wood doors, and interior finish. If five or more stories, it must be of fire resistive materials throughout.
11. Wisconsin--Construction of four story buildings same as the recommendation with fire ratings substantially the same as specified in the Underwriters' Code. All buildings limited to four stories. In three-story buildings ordinary construction may be used above the third floor level.

Inasmuch as the fire rating for the various construction members and portions of buildings in terms of hours is infrequently specified, it is impossible to compare or contrast with accuracy the requirements with the recommendations of the National Council and the specifications set forth in the Underwriters' Code.

It appears, however, that the requirements in effect in the following states are substantially equal to the recommendation: California, Connecticut, Maryland (for three-story buildings), Michigan, Pennsylvania (for three- and four-story buildings), Wisconsin (for four-story buildings).

Requirements in effect in Florida and Idaho are without doubt lower than those set up in the recommendation.

Those in New Jersey seem to be higher in all respects except in respect to the construction of the roof which does not measure up to that specified in the Underwriters' Code.

Wisconsin with requirements for buildings of four stories substantially equal to the recommendation, fails to apply these same requirements to buildings of three stories.

The requirements in the following states seem to exceed the recommendation: Ohio, Maryland (for buildings of four or more stories), Pennsylvania (for buildings of five or more stories).

Limitations in the height of buildings are imposed in the following states: Delaware--two stories above the basement; Ohio--three stories; Wisconsin--four stories.

While requirements in a few states are specific enough to be useful and establish standards equal to the recommendation of the National Council, the number of states with such requirements is small. It should be noted that there are no state requirements specifying automatic sprinkler protection for certain areas as is recommended by the National Council.

Fire Resisting Requirements for Buildings Higher than Six Stories

The National Council makes the following recommendations for buildings of more than six stories.

7. That buildings in excess of six stories or more than seventy-five feet above grade at any point, be of fireproof construction as defined by the "Underwriters' Code"; finish floors only may be of wood. Areas having combustible contents exceeding thirty pounds per square foot of floor area to be provided with automatic sprinkler protection.

No state has requirements following a similar classification of story height. No alternative remains but to assume that the specifications applying to buildings of the maximum height for which requirements are in effect, prevail for buildings that exceed the story height mentioned. It is, however, unlikely that in many states minimum requirements for buildings exceeding six stories are needed inasmuch as buildings of this height are very infrequently planned or constructed.

Stair Enclosures or Fire Towers

Five recommendations are made by the National Council providing for stair enclosures or fire towers for buildings and specifying certain details of their construction.

Eleven states have minimum requirements of this kind. However, in a number of instances specifications are not given in detail. Neither is it stipulated that they must be constructed in accordance with the Underwriters' Code, as is done in the recommendation of the National Council.

8. That in two-story buildings of less than semi-fire-proof construction fire towers be required.

The following six states require fire towers as indicated below.

1. California--all two-story buildings
2. Illinois--all two-story buildings
3. Maryland--stairs with fire enclosures on three sides
4. New Jersey--all two-story buildings
5. Ohio--basement stairways only
6. Pennsylvania--at least one required means of exit

It is disappointing to find that so few states have adopted requirements specifying fire towers or stair enclosures for two-story buildings of less than semi-fireproof construction. On the other hand, California and New Jersey require fire towers for all two-story buildings irrespective of the construction. Illinois likewise requires fire towers for all two-story buildings but permits the substitution of fire escapes for such towers. Requirements in Ohio and Pennsylvania do not equal the recommendation of the National Council.

9. That in buildings more than two stories in height all exit stairs be of the enclosed or fire tower type.

Nine states specify fire towers for all buildings of more than two stories.

1. California
2. Connecticut
3. Illinois
4. Maryland
5. New Jersey
6. Ohio--the stairwall need be enclosed and separated from the basement corridor only.
7. Pennsylvania--at least one required means of egress.
8. South Carolina
9. Wisconsin--fire escapes may be substituted, on temporary and in unit buildings.

It is impossible to explain why so few states have enacted requirements for such an essential safety factor. While there can be little doubt that architects specify stair enclosures or fire towers for almost all buildings of three or more stories and for many two-story buildings, it would nevertheless seem highly important that such provisions be included in all state requirements. It is apparent that there is considerable lag between good practice and requirements, making such practice mandatory.

10. That such enclosures be constructed in accordance with the "Underwriters' Code."

Only four states, California, Connecticut, Virginia, and Wisconsin, have specifications that approximate the Underwriters' Code. The Underwriters' Code stipulates that such partitions shall be constructed of approved masonry or reinforced concrete, or other approved form of construction of noncombustible materials and shall have a fire rating of at least two hours. The four states indicated require a fire rating of two hours. While the requirements in none of these states refer specifically to the Underwriters' Code, nevertheless, they do establish an equivalent standard. No other states specify a fire rating for such construction.

11. That the partitions separating the corridor from the stair hall may be of wire glass in metal frames or of approved glass block; doors in such partitions to be of clear wire glass in metal frames, equal to class B as defined by the Underwriters' Laboratories, and provided with self-closing devices.

Eight states have requirements of this kind. Although none of these requirements specify doors equal to Class B as defined by the Underwriters' Laboratories, they do specify this construction in such terms that a comparison is possible. Following are the eight requirements concerning this aspect of construction.

1. California--same.
2. Connecticut--same.
3. Delaware--same.
4. Illinois--same except that self-closing doors are not specified.
5. Maryland--same if the building is of three or more stories.
6. Ohio--same in all buildings of composite construction and in all buildings of more than three stories. In buildings of not more than three stories and of fireproof construction, basement story only need be separated from the stairhall.
7. Pennsylvania--same. Doors may be self-closing or double acting.
8. Wisconsin--same.

It is at once apparent in almost every instance that the requirements, where such exist, are equal to the recommendation of the National Council.

12. That doors in required stair enclosures, if kept normally open, shall be provided with fusible link holds or equivalent devices and shall also be provided with friction devices of a type that may be readily disengaged, and arranged so that the doors will be released by heat or may be readily released manually.

There are no state requirements making similar provisions except in California. Requirements in effect in all states stipulate self-closing doors. It is safe to assume that such doors are to remain closed when not in immediate use.

Chimneys

The last item of general construction included in the recommendations of the National Council is chimneys. Two recommendations are made concerning materials to be employed in their construction.

13. That all chimneys and smoke flues be constructed of brick, stone, reinforced concrete, or hollow masonry blocks.

Only the five following states specify the materials to be used in the construction of chimneys: California, Idaho, Maryland, Pennsylvania, and Wisconsin.

The requirements in all cases are almost identical to the recommendation.

14. That they be lined with fire clay lining or other refractories suitable for temperatures encountered. The fire rating of materials is to be based upon the specifications of the A.S.T.M. (American Society for Testing Materials) for fire tests and performance reports of the National Bureau of Standards, National Board of Fire Underwriters, or other accepted testing laboratories.

Eight states have requirements specifying the kind of chimney lining. None, however, require the fire rating to be based on the specifications of the A.S.T.M. or standard performance ratings.

1. California--same.
2. Idaho--same.
3. Maryland--same.
4. Michigan--same.
5. New Jersey--same.
6. Pennsylvania--same.

7. South Carolina--terra cotta lining unless chimney walls are at least eight inches thick.
8. Wisconsin--adapted to withstand reasonable high temperatures. Salt glazed fire clay if either gas or fuel oil is used.

It is clear that where requirements are in effect governing the materials and construction of chimneys they substantially equal the specifications contained in the recommendations.

Summary

Where minimum requirements are found, they, in general, establish standards substantially equivalent to the recommendations of the National Council. There are, however, exceptions. The most obvious and serious omissions are lack of minimum requirements of any kind.

Only fifteen states have requirements establishing standards of construction for one-story buildings. In all except two the requirements seem to specify construction equal to, and in a few instances higher than that recommended by the National Council.

Sixteen states have requirements applying to the construction of two-story buildings. It seems clear that the requirements in seven of these sixteen states establish construction standards substantially equal to those specified in the recommendations of the National Council. In six states the requirements exceed those recommended. In only three states do the requirements appear to fall short of the recommendations of the National Council.

Only six states have requirements specifying the type of roof covering and but two of these specify at least Class B as set up by test specifications of the Underwriters' Laboratory.

A rather wide variation in standards established by requirements for heater and fuel rooms is found. While a total of eighteen states have requirements relating to this aspect of general construction, in at least nine instances the requirements are so indefinite or are stated in such general terms as to preclude comparison with the specifications adopted by the Underwriters' Code as recommended by the National Council. In at least three states the requirements permit standards of construction below those established by the code.

Only eleven states have requirements for buildings of

three or more stories. In all but three instances the requirements seem to specify construction equal to or exceeding that specified by the recommendation.

Only six states require that stairways be enclosed in fire tower construction for two-story buildings and only nine require such construction for buildings of more than three stories. In only four states is it required that such fire towers be constructed according to the Underwriters' Code. Requirements relating to stair enclosures have been frequently neglected even in those states with requirements specifying the kind of general construction. Such neglect is serious in light of the extreme importance of this aspect of building as a safety factor. It may be noted that the influence of the Building Code of the National Board of Fire Underwriters and the type classification of construction established by the American Institute of Architects is apparent in almost all of the codes.

It should also be emphasized that the great majority of states have no minimum requirements relating to general construction. This is indeed a regrettable situation and indicates a serious neglect of the most important and elemental safety considerations on the part of those states without such requirements.

CHAPTER IV

CORRIDORS, STAIRWAYS, AND EXITS

Corridors

The National Council on Schoolhouse Construction has formulated a list of eight recommendations relating to several important aspects of the construction of corridors. These are in addition to the recommendations that relate to corridors in the section on General Construction discussed in Chapter III.

Twenty-six states have minimum requirements relating to one or more of these aspects or factors of construction included in the recommendations of the National Council. Those states which have requirements corresponding to each of the recommendations of the National Council on Schoolhouse Construction relating to corridors are indicated in Table 3.

Table 3 shows that the largest number of requirements are directed at the most obvious and probably more vital aspects of construction which contribute to safety rather than to the less obvious and detailed aspects. Requirements concerning the width of corridors, their termination, and the specifications for doors from the corridors into stairways, all of which are both obvious and vital to safety, are enacted much more frequently than other requirements. The total number of states, twenty-six, with one or more requirements relating to corridors as they affect safety of the occupants, indicates that considerable attention is directed to providing at least some measures of safety in this aspect of schoolhouse construction.

Table 3, by reading across, also reveals the fact that only a few states have developed a sufficient number of requirements to constitute adequate codes. Only eight states have requirements concerning five or more of the aspects of corridor construction covered in the recommendations of the National Council. Two states, Connecticut and Maryland, have seven such requirements, while Virginia has eight. In general, the total requirements for most of the states form at best fragmentary and incomplete codes.

TABLE 3

STATES HAVING REQUIREMENTS CONCERNING CORRIDORS
CORRESPONDING TO THE RECOMMENDATIONS
OF THE NATIONAL COUNCIL

States	Recommendations of the National Council by Numbers*								Total
	Width		Pro- jec- tions	Equip- ment	Ter- mina- tion	Doors to Stairways		Con- struc- tion	
	1	2	3	4	5	6	7	8	
Alabama.....	x	x	.	x	x	x	.	.	5
Arizona.....	.	.	.	.	.	x	.	.	1
California....	x	x	.	.	x	x	.	.	4
Colorado.....	.	.	.	.	.	x	.	.	1
Connecticut...	x	x	x	x	x	x	x	.	7
Delaware.....	x	.	.	.	.	x	x	x	4
Florida.....	x	x	.	.	x	.	x	x	5
Idaho.....	x	x	x	x	.	x	x	.	6
Illinois.....	.	.	.	.	.	x	x	.	2
Indians.....	.	.	.	.	.	x	x	.	2
Kansas.....	.	.	.	.	.	x	.	.	1
Kentucky.....	x	x	.	.	x	x	x	.	5
Maine.....	.	.	.	.	.	x	.	.	1
Maryland.....	x	.	x	x	x	x	x	x	7
Massachusetts	x	x	.	.	x	.	.	.	3
New Jersey....	.	.	.	.	.	x	.	x	2
North Dakota..	.	.	.	.	.	x	x	.	2
Ohio.....	x	.	.	.	x	x	x	.	4
Pennsylvania..	x	x	.	.	.	x	x	.	4
South Carolina	x	.	.	x	.	x	x	.	4
South Dakota..	.	.	.	.	.	x	.	.	1
Texas.....	.	.	.	.	.	x	.	.	1
Vermont.....	.	.	.	.	.	x	.	.	1
Virginia.....	x	x	x	x	x	x	x	x	8
West Virginia.	x	x	.	.	.	.	.	.	2
Wisconsin.....	x	x	.	.	x	x	x	.	5
Total.....	15	11	4	6	10	23	14	5	...

*1. Width of main corridors (p. 40); 2. Width of secondary corridors (p. 40); 3. Limitations of wall projections to 8 inches (p. 42); 4. Recessed corridor equipment (p. 42); 5. Termination of corridors (p. 43); 6. Specifications for doors into stair enclosures (p. 44); 7. Doors opening into stairways (p. 45); 8. Construction of corridors (p. 45).

Following are the eight recommendations and the states having requirements for these factors together with a brief digest of the requirements in each case where it differs from the recommendation of the National Council.

Width

1. That the minimum clear passageway of the main corridor or corridors of any school building containing four classrooms or more be eight and one-half feet.

1. Alabama--determined by number of rooms served.
2. California--6 ft.
3. Connecticut--8 ft. in buildings of 6 or fewer rooms, 10 ft. in larger elementary and small high schools, 11 to 12 ft. in larger high schools.
4. Delaware--8 ft.
5. Florida--8 ft.
6. Idaho--8 ft.
7. Kentucky--8 ft.
8. Maryland--Same.
9. Massachusetts--8 ft. for buildings of 8 rooms per story plus 1 1/2 ft. for each additional 2 rooms.
10. Ohio--not less than the width of the stairway or exit.
11. Pennsylvania--a. 8 ft. for up to 6 rooms frame construction plus 1 ft. for each additional 2 rooms.
b. 8 ft. for up to 8 rooms slow burning construction plus 1 ft. for each additional 4 rooms.
c. 8 ft. for up to 10 rooms fire-resistant construction plus 1 ft. for each additional 6 rooms.
12. South Carolina--8 ft.
13. Virginia--Same.
14. West Virginia--12 ft.
15. Wisconsin--equal to the combined width of stairways or passageways leading to it if it serves as means of egress.

It is apparent that the requirements in those states specifying minimum widths for main corridors, with the exception of California, substantially meet the recommendation of the National Council. Of those specifying minimums in terms of feet, none excepting California is more than one-half foot less than the recommended minimum. Connecticut and Pennsylvania both require additional width as the size of the building increases.

2. That the minimum clear passageway of secondary corridors vary with the length of such corridors and the number of classroom doors leading to them, but such secondary corridors shall be not less than 88 inches in width, clear of all fixed and

movable obstruction including swing of room and locker doors. The same procedure is followed in tabulating the width of secondary corridors as was employed for main corridors.

TABLE 4

WIDTH OF SECONDARY CORRIDORS SPECIFIED IN STATE CODE

States	Width in Inches
1. Alabama.....	60
2. California.....	72
3. Connecticut.....	72
4. Florida.....	72
5. Idaho.....	60
6. Kentucky.....	60
7. Massachusetts.....	72*
8. Pennsylvania.....	60
9. Virginia.....	60
10. West Virginia.....	60
11. Wisconsin.....	48

*If occupants average more
than 10 per room.

A comparison of the data relating to the minimum width of main corridors and secondary corridors shows that four fewer states have minimum requirements concerning secondary corridors. From the data collected, it is impossible to determine with certainty whether the requirements governing main corridors apply also to secondary corridors in these four instances. From the wording of the regulations, however, it seems reasonable to assume that such might be the case.

It may be noted in Table 4 that the minimum widths of secondary corridors required by the states are in general less than those recommended by the National Council. While these lesser requirements no doubt may result in somewhat lower building costs, it is questionable if this is wise economy in light of the importance of this factor on safety.

In the instances where states have established minimum widths for corridors, either main or secondary, the requirements are quite uniform, with any substantial variation being excep-

tional. It is difficult to understand, however, why only fifteen states have established minimum requirements for a factor which is so important to pupil safety.

Wall Projections

Another safety factor directly related to corridor width is wall projections. The recommendation of the National Council is as follows.

3. That no projections beyond the face of the corridor walls be in excess of eight inches.

Only four states have any requirement of a similar kind.

1. Connecticut--same.
2. Idaho--same.
3. Maryland--4 inches.
4. Virginia--10 inches.

Virginia also specified that all classroom doors open into rooms unless they are so recessed that the doors do not open into the corridors. This is a violation of the accepted practice and appears to constitute a safety hazard to pupils within the classrooms in case of emergency, but is no doubt designed to expedite corridor movement of pupils.

The few states with requirements concerning wall projections in corridors seems to indicate that the requirements concerning minimum clear passageways are regarded as sufficient to insure safety.

Corridor Equipment

Still another factor directly related to corridor width is the installation of corridor equipment. Following is the recommendation of the National Council concerning such installation and the states with similar requirements.

4. That no radiators, drinking fountains, wash-basins, or other equipment be placed on corridor walls unless the latter be recessed to receive them.

1. Alabama--same.
2. Connecticut--same.
3. Idaho--same.
4. Maryland--same.
5. South Carolina--recommended as desirable.

6. Virginia--same.

As in the case with wall projections the fact that so few states require that corridor equipment be recessed seems to indicate that such construction is not generally regarded as essential to safety.

Termination

A factor of great importance to the safety of the building occupants, particularly in case of emergency, is the termination of the corridors. A comparison of the state requirements with the National Council recommendation follows.

5. That each end of every corridor terminate on an egress or a stairway, excepting that pockets not to exceed the length of one classroom may be planned when conditions dictate, but in no case shall this distance exceed 35 feet.

1. Alabama--same.
2. California--pockets limited to 10 ft.
3. Connecticut--same.
4. Delaware--same.
5. Kentucky--no pockets permitted.
6. Maryland--same.
7. Massachusetts--no pockets permitted.
8. Ohio--no pockets.
9. Virginia--same.
10. Wisconsin--pockets permitted only if the classroom door is not more than 10 feet from the exit door or stairway.

It is surprising that only ten states have requirements concerning this very important aspect of building safety. It is highly probable that with few exceptions most modern school buildings conform to this recommendation even without the necessity of meeting minimum requirements. Possibly this apparent lack of need explains the absence of such requirements in the states where such regulations are not in effect.

Doors to Stairways

It has been noted in Chapter III that nine states require stair enclosures or fire towers under certain circumstances and for certain types of construction. This is likewise the recom-

mendation of the National Council. In other instances where such stair enclosures or fire towers are not required, there is nevertheless one usual requirement relating to corridor doors opening into stairways, namely, that the doors must swing out or with the exit travel. Below is the recommendation of the National Council together with requirements by states.

6. That all doors from corridors into stair enclosures be of self-closing type, swing with the exit travel, and be smoke resistive. They shall be light doors of metal or shall be metal covered, or other types, with clear wire-glass panels, and shall be equal to Class B doors as defined by the Underwriters' Laboratories.

1. Alabama--Swing with exit travel.
2. Arizona--Swing with exit travel.
3. California--Same.
4. Colorado--Swing with exit travel.
5. Connecticut--Same.
6. Delaware--Same.
7. Idaho--Swing with exit travel.
8. Illinois--Same.
9. Indiana--Swing with exit travel.
10. Kansas--Swing with exit travel.
11. Kentucky--Same--at least 3 ft. wide.
12. Maine--Door swing with exit travel if the building is more than one story.
13. Maryland--Same.
14. New Jersey--Same with the exception that heavy wood doors are permissible.
15. North Dakota--Doors swing with exit travel.
16. Ohio--Same.
17. Pennsylvania--Same. Doors must be at least 5 ft. wide in the clear and no single glass panels more than 280 sq. in.
18. South Carolina--Swing with exit travel.
19. South Dakota--Swing with exit travel.
20. Texas--Swing with exit travel.
21. Vermont--Swing with exit travel.
22. Virginia--Swing with exit travel.
23. Wisconsin--Same.

The above tabulation shows that only nine states have requirements which meet the recommendation of the National Council.

A further recommendation of the National Council is:

7. That no door opening into a stairway shall swing across or into the required line of travel of such stairway.

Fourteen states have regulations or requirements which are similar or seem to mean substantially the same. These states are listed below.

- | | | |
|----------------|-----------------|--------------------|
| 1. Connecticut | 6. Indiana | 11. Pennsylvania |
| 2. Delaware | 7. Kentucky | 12. South Carolina |
| 3. Florida | 8. Maryland | 13. Virginia |
| 4. Idaho | 9. North Dakota | 14. Wisconsin |
| 5. Illinois | 10. Ohio | |

Construction

The eighth and last recommendation of the National Council concerning corridors relates to a detail of construction which, while important to safety, is probably less vital than the preceding recommendations.

8. That all corners of all walls or projections including, or being a part of all stairways or walkways, have well-rounded corners of as large a radius as feasible, or such corners or projections be splayed at an angle of 45 degrees. This construction is to eliminate sharp and right-angle corners.

As might be expected, only a few states (California, Maryland, Pennsylvania, and Virginia) have similar requirements.

In addition to the requirements concerning fire resistant construction as applying to corridors found under general construction, Chapter III, five states have requirements of this kind placed in the specifications or sections dealing specifically with corridors. These states and the requirements in effect are as follows:

1. Delaware--Fireproof floors, walls, and ceilings.
2. Florida--Fireproof or fire resistive.
3. Maryland--Fire resistive if two or more stories.
4. New Jersey--Walls and floor of fireproof material.
5. Virginia--Fireproof construction if more than one story high.

In all five instances, the requirements listed in the specifications for corridors are duplications of the requirements found in Chapter III entitled "General Construction."

In addition, Connecticut specifies that all corridors shall be acoustically treated.

TABLE 5

STATES HAVING REQUIREMENTS CONCERNING STAIRWAYS
CORRESPONDING TO THE RECOMMENDATIONS
OF THE NATIONAL COUNCIL

States	Recommendations of the National Council by Number*							
	Number			Con- struc- tion	Location		Width	
	1	2	3	4	5	6	7	8
Alabama.....	x	.	.	x	.	.	x	.
Arkansas.....	.	.	.	.	.	.	.	.
California.....	x	.	.	x	x	.	x	x
Colorado.....	.	.	.	.	.	.	.	.
Connecticut.....	x	x	x	x	x	x	x	x
Delaware.....	x	.	.	x	x	x	x	.
Florida.....	x	x	.	x	x	.	x	x
Idaho.....	x	.	x	.	x	x	x	.
Illinois.....	x	x	.	.	.	.	.	.
Indiana.....	x	.	.	.	.	.	.	.
Kansas.....	x	.	.	.	.	.	.	.
Kentucky.....	x	.	x	x	.	.	x	x
Maine.....	x	.	.	.	.	.	.	.
Maryland.....	x	.	.	x	x	x	x	.
Massachusetts....	.	.	.	.	.	.	.	.
Michigan.....	x	.	.	.	.	.	.	.
New Jersey.....	x	x	.	x	x	.	x	x
New York.....	x	.	.	.	.	.	.	.
North Dakota....	.	.	.	.	.	.	x	.
Ohio.....	x	.	.	.	.	.	x	x
Pennsylvania....	x	x	.	x	x	.	x	x
South Carolina..	x	x	.	.	.	.	x	.
Texas.....	x	.	.	.	.	.	.	.
Vermont.....	x	.	.	x	.	.	x	.
Virginia.....	x	x	.	.	.	.	x	x
West Virginia...	x	.	.	x	.	.	x	.
Wisconsin.....	x	.	.	x	x	.	x	.
Total.....	23	7	3	12	9	4	17	8

*1. Two required for two-story buildings (p. 49); 2. Number based on occupancy (p. 50); 3. Two stairways with common landing (p. 51); 4. Materials used in construction (p. 51); 5. Location in relation to exits (p. 52); 6. Location in relation to "pockets" (p. 52); 7. Minimum width (p. 53); 8. Uniform width (p. 54); 9. Number of risers per run (p. 54); 10. Height of risers and width of tread (p. 55); 11. Requirements of safety treads (p. 56); 12. Prohibits use of winders (p. 57); 13. Place and width of landings (p. 57); 14. Handrails (p. 58); 15. Storage closets (p. 59); 16. Substitution of ramps (p. 59); 17. Specifications for ramps (p. 60).

TABLE 5--Continued

Recommendations of the National Council by Number*

Runs	Risers and Treads	Safety Treads	Wind- ers	Land- ings	Hand- rails	Storage Closets	Gradients or Ramps		Total
9	10	11	12	13	14	15	16	17	
x	x	.	x	x	x	.	.	.	8
.	x	.	.	.	x	.	.	.	2
x	x	x	x	x	x	.	x	x	13
.	x	.	.	.	x	.	x	x	4
x	x	x	x	x	x	x	x	x	17
.	x	.	x	x	x	x	.	.	10
x	x	.	x	x	x	x	x	x	15
x	x	x	x	x	x	.	x	x	13
.	.	.	x	.	x	.	.	.	4
.	.	.	.	.	x	.	.	.	2
.	.	.	.	.	.	.	.	.	1
x	x	.	.	x	x	x	.	.	10
.	x	.	.	.	.	.	.	.	2
x	x	x	x	x	x	x	.	.	12
.	x	.	.	.	.	.	.	.	1
.	.	.	.	.	.	.	.	.	1
x	x	.	x	x	x	.	.	.	10
.	x	.	.	.	x	x	.	.	4
.	.	.	x	x	.	.	.	.	3
x	x	.	x	x	x	x	x	x	11
x	x	.	x	x	x	x	x	x	14
.	x	.	x	x	x	.	.	.	7
.	.	.	x	x	x	.	.	.	4
x	.	.	x	.	x	x	x	x	9
x	x	x	x	x	x	x	.	.	11
x	x	.	x	x	x	.	.	.	11
x	x	x	x	x	x	.	x	x	8
									12
14	20	6	18	17	22	10	9	9	...

Stairways

Of equal importance in providing for the safety of occupants in case of fire or other emergency are requirements to be observed in the planning and construction of stairways. Requirements for stair enclosures or fire towers have been tabulated and discussed under general construction in Chapter III. In addition, the National Council has formulated a list of seventeen more detailed recommendations dealing with eleven aspects or factors of stairway construction that are most essential for the greatest degree of safety.

Table 5 shows states having requirements corresponding to the recommendations of the National Council relating to stairways. Reading across it serves to indicate the relative adequacy of the code in effect in each state. Reading down it serves to indicate the relative importance that seems to be attributed to each of the seventeen factors which is a subject of recommendation by the National Council.

Table 5 shows which requirements regulating aspects of stairway construction are most frequently enacted. This is true of requirements relating to number of stairways, width, runs and landings, height of risers, width of treads, disapproval of winders and required installation of handrails. While these requirements are essential to safety, it is also true that other aspects of construction which are less frequently the subject of regulations are also essential to safety. The number of requirements in effect concerning stairways are more numerous than those in effect relating to corridors.

The table shows, by reading across, that thirteen states have requirements corresponding to more than one-half of the seventeen recommendations of the National Council. Seven states have requirements corresponding to twelve or more of these recommendations. In these seven instances, it is probably safe to conclude that the requirements constitute fairly adequate codes. While requirements regulating the construction of stairways are rather frequently found, it must nevertheless be admitted that in the majority of states the codes are still incomplete and fragmentary. It is likely that not more than seven states have established codes that are even fairly adequate. The same procedure employed throughout this study is used in comparing the state requirements with the recommendations of the National Council.

Number

1. That no building of two stories or more have fewer than two main stairways remote from each other.
 1. Alabama--same.
 2. California--same.
 3. Connecticut--same plus one additional for each floor above the first floor accommodating 300 pupils.
 4. Delaware--same.
 5. Florida--same.
 6. Idaho--same if 4 classrooms or the auditorium are located on the second floor.
 7. Illinois--1 or else exterior sliding fire escape for each 100 seating capacity above first floor and each 50 seating capacity above second floor.
 8. Indiana--proper ways of egress. If more than 2 stories 1 or more outside fire escapes.
 9. Kansas--same--in addition stair exits for rooms above first story must be separate from first floor exits or else fire escapes are required.
 10. Kentucky--same.
 11. Maine--if more than one story at least separate stairs, either inside or outside.
 12. Maryland--same.
 13. Michigan--same.
 14. New Jersey--same--in addition if 9 or more rooms are on second floor, 3 stairways.
 15. New York--same.
 16. Ohio--same.
 17. Pennsylvania--same.
 18. South Carolina--same.
 19. Texas--same.
 20. Vermont--same.
 21. Virginia--same.
 22. West Virginia--same.
 23. Wisconsin--same.

The fact that twenty-three states have regulations concerning the number of stairways shows that a high percentage of states with regulations of any kind rightly regard this as one of the most important safety factors. Idaho qualifies this recommendation by limiting it to buildings with four rooms or auditorium on the second floor. Indiana does not specify the number of stairways, employing the words "proper means." Illinois and Maine permit the substitution of outside fire escapes. Only

these four states have lower requirements than the recommendation of the National Council. The minimum requirements of Connecticut and New Jersey go beyond this recommendation. Whether the higher factors of safety required in these two instances are justifiable is questionable.

The second recommendation of the National Council relating to stairways is also concerned with the number of stairways.

2. The number of stairways and exits to be determined by the exit formula of the National Fire Protection Association as found in their current Building Exits Code.

Only two states, Florida and Virginia, make this specific requirement. However, states with further requirements than that specified by recommendation No. 1 are listed below with the requirement in effect.

1. Connecticut--One unit of width (24 inches) for each 60 pupils or major fraction thereof, or 40 sq. ft. of gross floor area on floors above the first floor.
2. Illinois--One stairway for each 100 occupants or fraction thereof above the first floor, for each 50 occupants or fraction above the second floor.
3. New Jersey--3 required if 9 or more rooms are on the second floor.
4. Pennsylvania--Based on number of occupants per floor and shall be according to the following tables:

TABLE 6

STAIRWAY REQUIREMENTS FOR BUILDINGS
OF NOT MORE THAN TWO STORIES

Capacity			Required Exits		
Ordinary Construc- tion	Slow Burning Construc- tion	Fire- Resistive Construc- tion	One- Story Bldgs.	Multiple Story Buildings	
				1st Floor	2nd Floor
Up to 300	Up to 360	Up to 400	2	3	2
300 to 450	361 to 450	401 to 600	3	4	3
1 addi- tional for each 100 over 450	1 addi- tional for each 180 over 450	1 addi- tional for each 200 over 600			

TABLE 7

STAIRWAY REQUIREMENTS FOR BUILDINGS
OF MORE THAN TWO STORIES

Capacity Fire Resistive (required)	Required Exits	
	1st Floor	Above 1st Floor
Up to 250.....	3	2
251 to 500.....	4	3
1 additional for each 300 over 500.		

5. South Carolina--one for each 4 rooms and not over each 250 pupils.

It appears that an urgent need exists for additional minimum requirements in all but these five states. This need is accentuated by the fact that stairways not only serve as means of circulation for the building occupants but as means of egress in case of fire or other emergency. While the great majority of states with requirements of any kind do require at least two stairways, it is obvious that there should be further requirements in the interest of safety to provide for the great variations in building sizes and enrollments.

The third recommendation of the National Council concerning stairways provides a further safety measure.

3. That two stairways with a common end landing or the same intermediate landing or platform shall be considered as a single stairway.

Only three states, Connecticut, Idaho, and Kentucky, have adopted similar requirements. That other states have neglected to establish such a requirement may be due to the fact that such construction is not usual or common in school buildings.

Construction

It is recommended by the National Council that construction of stairs conform to the following specifications.

4. All main stairs in school buildings of two stories or more be built of incombustible construction throughout. (Handrails are exempt from this requirement.) Stairtreads and landings shall be solid without perforations.

Following are the states with similar requirements.

1. Alabama--Fire-resistive.
2. California--Wood construction permitted if protected on the under side by not less than one-hour fire-resistive construction.
3. Connecticut--Same.
4. Delaware--Same.
5. Florida--Fireproof or fire-resistive.
6. Kentucky--Fire-resistive.
7. Maryland--Fire-resistive.
8. New Jersey--Same.
9. Pennsylvania--Same.
10. Vermont--Fireproof when possible.
11. West Virginia--Fire-resistive.
12. Wisconsin--Same if more than two-story building.

Only twelve states have requirements of this kind in effect, and it is doubtful whether some of these requirements establish standards equal to that contained in the National Council's recommendation.

Location

Two recommendations of the National Council relate to the location of stairways.

5. That main stairways be located so that there is a direct exit from the ground floor in line with stairs.

Only nine states make this specific requirement. This may be explained by the fact that such is probably the usual type of construction in all modern or recent buildings. The importance of such construction, however, as a safety factor is obvious. The nine states with requirements of this type are listed below.

- | | |
|----------------|-----------------|
| 1. California | 6. Maryland |
| 2. Connecticut | 7. New Jersey |
| 3. Delaware | 8. Pennsylvania |
| 4. Florida | 9. Wisconsin |
| 5. Idaho | |

Maryland further requires that the exit must be at ground level.

6. That main stairways be not set in pockets or dead ends but fully open to egress.

Only four states have specific requirements of this kind in their codes, namely: Connecticut, Delaware, Idaho, and Maryland.

It is possible that in some instances regulations concerning other aspects or elements of construction may imply that the construction of stairways conform to either or both of the above recommendations. However, in each instance such implication is either not clear or is subject to misinterpretation. Assuming that such requirements are necessary to safety, it is apparent that there is need for specific regulations in all but the few states which now have them.

Width

The National Council makes two recommendations concerning width of stairs.

7. That the width of main stairways be not less than 44 inches. All such width to be clear of obstruction except that handrails may project not more than 3 1/2 inches at each side within the above width.

Seldom are state requirements so specific as to include any specifications concerning projection allowances for handrails. Wherever such specifications are found, they are included in the tabulation of requirements found below.

1. <u>Alabama</u>	48 inches.
2. <u>California</u>	60 inches exclusive of handrails.
3. <u>Connecticut</u>	48 inches.
4. <u>Delaware</u>	48 inches between handrails.
5. <u>Florida</u>	Same.
6. <u>Idaho</u>	60 inches (42 inches for minor stairways).
7. <u>Kentucky</u>	Same.
8. <u>Maryland</u>	Same.
9. <u>New Jersey</u>	48 inches.
10. <u>North Dakota</u>	48 inches.
11. <u>Ohio</u>	Not less than 3 ft. nor more than 6 ft. between handrails.
12. <u>Pennsylvania</u>	Same.
13. <u>South Carolina</u> ...	Same (handrails may project but 3 inches).
14. <u>Vermont</u>	48 inches (20 inches per 100 persons in places of assembly).

15. Virginia..... 48 inches and not more than
66 inches.
16. West Virginia... 48 inches.
17. Wisconsin..... Same (handrails may project
4 inches).

It may be noted that with two exceptions, there is little variation in the requirements of the seventeen states having such regulations, and that with one exception, namely Ohio, all requirements are equal to the recommendation of the National Council. In only two states, California and Idaho, do the minimum requirements substantially exceed this recommendation of forty-four inches. Idaho, however, permits a minimum width of forty-two inches for minor stairways, although no clear distinction is made between main and minor stairways. Two states establish a maximum width, Ohio with a limitation of seventy-two inches and Virginia with sixty-six inches.

These data indicate rather general agreement as to the desirable minimum width for stairways.

The second recommendation relating to width follows:

8. The same width shall be maintained through the entire length of the stairway.

Only the eight states listed below have similar requirements.

- | | |
|----------------|-----------------|
| 1. California | 5. New Jersey |
| 2. Connecticut | 6. Ohio |
| 3. Florida | 7. Pennsylvania |
| 4. Kentucky | 8. Virginia |

It is probably safe to assume that neglect to establish such a requirement should not be interpreted as approval of construction contrary to this recommendation. A lack of uniform width throughout a stairway is probably so unusual that need for such regulations has not been generally encountered.

Runs

The ninth recommendation on stairways of the National Council is also concerned with safety to the building occupants.

9. That each main stairway from story to story be in two runs, with not more than 16 risers to the run. No stairway of less than 3 risers shall be used.

Thirteen states have requirements concerning this factor.

- | | |
|------------------------------|--|
| 1. <u>Alabama</u> | Maximum 18, minimum 3. |
| 2. <u>California</u> | Maximum 17, no minimum. |
| 3. <u>Connecticut</u> | Not more than 8 ft. height between landings. |
| 4. <u>Florida</u> | Same. |
| 5. <u>Idaho</u> | Same. |
| 6. <u>Kentucky</u> | Same maximum, no minimum. |
| 7. <u>Maryland</u> | Same. |
| 8. <u>New Jersey</u> | 2 runs with intermediate landings. |
| 9. <u>Ohio</u> | Maximum 18, minimum 3. |
| 10. <u>Pennsylvania</u> | Maximum 15. |
| 11. <u>Vermont</u> | Maximum 15. |
| 12. <u>Virginia</u> | Same. |
| 13. <u>West Virginia</u> ... | 2 runs of same length. |
| 14. <u>Wisconsin</u> | Maximum 18, minimum 3, 22 permitted if no intervening landing or platform. |

Requirements specifying the number of steps seem to vary somewhat in a number of instances from the recommendation, three states permitting a maximum of eighteen risers and two states limiting the maximum to fifteen.

Risers and Treads

Another important factor, not only affecting safety but also determining the degree of pitch or rake of the stairs is the height of the risers and width of tread.

10. That risers for main stairways may not exceed 6 1/2 inches and treads including nosing not less than 10 1/2 inches.

- | | |
|------------------------------|----------------------------|
| 1. <u>Alabama</u> | 7 and 11. |
| 2. <u>Arkansas</u> | 6 and 12. |
| 3. <u>California</u> | 7 1/2 and 11. |
| 4. <u>Colorado</u> | uniform throughout stairs. |
| 5. <u>Connecticut</u> | 7 1/2 and 10. |
| 6. <u>Delaware</u> | 7 and 12. |
| 7. <u>Florida</u> | 7 and 10. |
| 8. <u>Idaho</u> | 6 1/2 and 10 1/2 (same). |
| 9. <u>Kentucky</u> | 7 and 10 1/2. |
| 10. <u>Maine</u> | 6 to 7 1/2 and 10. |
| 11. <u>Maryland</u> | 7 1/2 and 11. |
| 12. <u>Massachusetts</u> ... | 7 1/2 and 10. |

13. New Jersey..... 7 and 12 (including nosings).
14. New York..... Elementary 6, high school
6 1/2 and 11.
15. Ohio..... 7 and 10 exclusive of nosing.
16. Pennsylvania... pitch or rake of 30 degrees.
Combined risers and treads not
more than 18 inches.
17. South Carolina. 6 1/2 and 11.
18. Virginia..... 6 1/2 and 10 1/2 same.
19. West Virginia.. 6 and 12.
20. Wisconsin..... 7 1/4 and 9 1/2.

The fact that nineteen states have requirements concerning this aspect of stair construction indicates that it is considered an important factor in safety, although there is some little variation in requirements.

It should be noted that eleven states permit the risers of more than six and one-half inches as recommended by the National Council. Architects are generally agreed that risers exceeding seven inches are dangerous and should be prohibited. However, five states permit risers of greater height than seven inches.

Safety Treads

A further recommendation in the interest of safety is made concerning treads by the National Council.

11. That the edges of all treads and edges of stairway landings be constructed and maintained so as to provide nonslip surfaces. If separate treads, nosings or other nonslip materials are provided, these are to be set flush with treads.

Only the five following states include this specific requirement.

1. California--surface material such as to avoid
danger of slipping.
2. Connecticut
3. Idaho
4. Maryland
5. Virginia
6. Wisconsin

Wisconsin stipulates that such nonslip surfaces be at least three inches in width.

It is difficult to explain the lack of this requirement

in so many instances unless it is assumed that a provision of this kind is customary in schoolhouse construction.

Winders

12. That no stairway for pupil use be constructed with winders, irrespective of whether stairway constitutes required means of egress.

Eighteen states have requirements prohibiting such construction.

1. Alabama	10. North Dakota
2. California	11. Ohio
3. Connecticut	12. Pennsylvania
4. Delaware	13. South Carolina
5. Florida	14. Texas
6. Idaho	15. Vermont
7. Illinois	16. Virginia
8. Maryland	17. West Virginia
9. New Jersey	18. Wisconsin

The obvious danger of winders explains the quite general prohibition of this type of construction.

Landings

The recommendation of the National Council concerning landings between stair runs and the state requirements of this kind are tabulated below.

13. That between runs, there shall be an intermediate landing of at least the same clear width as the stairway.

1. <u>Alabama</u>	Change in direction shall be by platform.
2. <u>California</u>	Same.
3. <u>Connecticut</u>	Same.
4. <u>Delaware</u>	Same.
5. <u>Florida</u>	Same.
6. <u>Idaho</u>	Same.
7. <u>Kentucky</u>	Same.
8. <u>Maryland</u>	Same.
9. <u>New Jersey</u>	Same.
10. <u>North Dakota</u>	Change in direction shall be by platform.
11. <u>Ohio</u>	Same.

12. Pennsylvania.... Same.
13. South Carolina.. Change in direction shall be by platform.
14. Texas..... One landing between floors, landing not less than 4 ft. wide.
15. Virginia..... Same.
16. West Virginia... Same.
17. Wisconsin..... Same except that in a straight run the landing may be reduced to 3 ft.

It is apparent that in general state requirements substantially equal the recommendation of the National Council.

Handrails

14. That handrails be provided on both sides of a stairway. Where stair width exceeds three units (22 inches each--66 total) intermediate handrails shall be provided.

State requirements of this kind are as follows:

1. Alabama--Both sides.
2. Arkansas--Both sides.
3. California--Both sides and 84 inch width requires center rail.
4. Colorado--Both sides if width is greater than 4 ft. and center rail if greater than 8 ft.
5. Connecticut--Both sides.
6. Delaware--Same.
7. Florida--Same.
8. Idaho--Both sides and 72 inches width requires center rail.
9. Illinois--Both sides.
10. Indiana--Proper handrails.
11. Kentucky--Both sides.
12. Maryland--Both sides and more than 51 inch width requires center rail.
13. New Jersey--Both sides.
14. New York--Both sides.
15. Ohio--Both sides and 72 inches width requires center rail.
16. Pennsylvania--Both sides and 8 ft. width requires center rail.
17. South Carolina--1 on each flight.
18. Texas--Both sides.

19. Vermont--Both sides and 72 inch width requires center rail.
20. Virginia--Both sides.
21. West Virginia--Both sides.
22. Wisconsin--Both sides if 5 ft. in width and 8 ft. width requires center rail.

The number of states requiring that handrails be installed indicates the importance attached to them as a factor of safety. There is, however, a considerable variation in the width requiring the installation of a center rail, such width varying from fifty-one to ninety-six inches.

Storage Closets

15. That no storage closet be placed under or over any stairway.

A total of ten states include this provision in their requirements:

- | | |
|----------------|-----------------|
| 1. Connecticut | 6. New York |
| 2. Delaware | 7. Ohio |
| 3. Florida | 8. Pennsylvania |
| 4. Kentucky | 9. Vermont |
| 5. Maryland | 10. Virginia |

In addition, New Jersey prohibits such closets being placed under any stairway, but does not prohibit placing them over a stairway.

Gradients or Ramps

A recommendation of the National Council permits the substitution of ramps for stairways. However a second recommendation limits the rise of pitch of such ramps.

16. That ramps be substituted for stairways in which case general requirements as for stairs and as designated in previous sections shall apply, except that no intermediate landings are required.

The following states have similar provisions; but, in some instances, additional restrictions are added which are noted below.

1. California
2. Colorado

3. Connecticut--if fewer than 4 risers would be required.
4. Florida
5. Idaho
6. Ohio--if not more than 3 risers would be required.
7. Pennsylvania
8. Vermont
9. Wisconsin--if it serves as exit to an assembly hall of more than 400 capacity and the exit rise is not more than 3 ft.

17. That ramps for these purposes shall not have more rise than 1 in 10.

Each of the above states likewise has such a requirement relating to the construction of ramps.

1. California--1 in 8.
2. Colorado--1 in 12.
3. Connecticut--Same.
4. Florida--Same.
5. Idaho--Same.
6. Ohio--1 in 12.
7. Pennsylvania--Same.
8. Vermont--Same.
9. Wisconsin--1 in 8.

It is impossible to draw any conclusions concerning the use of ramps in states other than those listed above. None of the other states have provisions either prohibiting or approving ramp construction.

Exits

Eight recommendations relating to various aspects of the planning and construction of exits are made by the National Council. These recommendations relate to the number of exits, exit doors, location in relation to classroom, corridor exit doors and outside steps.

Table 8 shows in summary form the requirements by states regulating the eight factors involved in the planning and construction of exits which correspond to those factors covered in the recommendations of the National Council on Schoolhouse Construction.

Table 8 shows that requirements corresponding to only

TABLE 8

STATES HAVING REQUIREMENTS CONCERNING EXITS
CORRESPONDING TO THE RECOMMENDATIONS
OF THE NATIONAL COUNCIL

States	Recommendations of the National Council by Number*								Total
	Number		Exit Doors				Loca- tion	Outside Steps	
	1	2	3	4	5	6	7	8	
Alabama.....	.	.	.	X	.	.	.	X	2
Arizona.....	.	.	.	X	.	.	.	.	1
Arkansas.....	.	.	.	.	.	.	.	X	1
California....	X	X	.	X	X	X	X	.	6
Colorado.....	X	.	.	X	.	.	.	.	2
Connecticut...	X	X	.	X	X	X	X	X	7
Delaware.....	X	.	X	X	.	X	X	X	6
Florida.....	.	.	.	X	.	.	.	X	2
Idaho.....	.	X	X	X	X	X	X	X	7
Illinois.....	X	.	.	X	.	.	.	.	2
Kansas.....	.	.	.	X	.	.	.	.	1
Kentucky.....	X	.	.	X	.	.	.	X	3
Maine.....	X	.	.	X	.	.	.	.	2
Maryland.....	.	.	.	X	.	X	X	X	4
Massachusetts.	X	.	.	.	.	X	.	.	2
Michigan.....	X	.	.	X	.	.	X	.	3
Missouri.....	.	.	.	X	.	.	.	.	1
Nebraska.....	.	.	.	X	.	.	.	.	1
New Jersey....	X	.	.	X	.	.	.	.	2
New York.....	.	.	.	.	.	.	.	X	1
North Dakota..	.	X	.	X	.	X	.	.	3
Ohio.....	X	.	.	X	.	X	.	.	3
Oklahoma.....	X	.	.	.	.	.	.	.	1
Pennsylvania..	X	X	.	X	.	X	X	X	6
South Carolina	X	.	.	.	.	.	X	.	2
Vermont.....	.	.	.	X	.	.	.	.	1
Virginia.....	.	X	X	X	X	X	X	X	7
West Virginia.	X	.	X	X	.	X	.	X	5
Wisconsin.....	X	X	.	X	.	X	.	.	4
Total.....	16	7	4	24	4	12	9	12	...

*1. Minimum number (p. 62); 2. Number of exits (p. 63);
3. Requirements concerning single and double-leaf doors (p. 64);
4. Antipanic locks (p. 64); 5. Unit width of door openings (p.
64); 6. Minimum width of doorways (p. 65); 7. Location in rela-
tion to classroom doors (p. 65); 8. Outside steps (p. 66).

two of the recommendations of the National Council are common: first, that requiring at least two exits; and second, that stipulating exit doors to be equipped with antipanic locks.

It also shows that probably not more than the seven states, California, Connecticut, Delaware, Idaho, Pennsylvania, Virginia, and West Virginia, have requirements that together constitute complete or adequate codes. Even several of these states have omitted certain requirements that are highly desirable in good safety practices.

It must be observed again that the absence of adequate minimum requirements in the State codes is difficult to understand, particularly because of the obvious and close relationship of exit provisions to the safety of building occupants.

The same procedure employed in tabulating requirements in previous sections of this study is employed here.

Number

1. That a single-story building of one or more rooms have at least two exits remote from each other.

1. California--for each floor above or below the ground floor.
2. Colorado--same.
3. Connecticut--same.
4. Delaware--same.
5. Illinois--same.
6. Kentucky--in buildings of 4 or more rooms.
7. Maine--in buildings of more than 1 story.
8. Massachusetts--same.
9. Michigan--same.
10. New Jersey--same.
11. Ohio--same.
12. Oklahoma--same.
13. Pennsylvania--same.
14. South Carolina--in buildings of more than 1 room.
15. West Virginia--same.
16. Wisconsin--in buildings of more than 1 room.

The importance of exits as a safety feature renders explanation difficult for the fact that thirty-two states have no requirements relating to the number of exits. Of the sixteen states that have requirements, only eleven require two exits for

all buildings, which is the recommendation of the National Council. It appears that a factor so essential to safety would be a subject of requirement in the case of every state which exercises any degree of regulation.

2. That in any building more than one story in height, exit doors be provided as recommended by the National Fire Protection Association (current Building Exits Code).

1. California--22 inches of width per 100 occupants.
2. Connecticut--same.
3. Idaho--same.
4. Massachusetts--two feet of width per 100 occupants.
5. Pennsylvania--depends on kind of construction and enrollment (see supra, pp. 50-51, Tables 6 and 7). Exit doors at least 5 ft. wide.
6. Virginia--same.
7. Wisconsin--fire-resistive building 30 inches of width per 100 occupants, frame or ordinary construction 40 inches per 100 occupants.

Here again it is astonishing to find so few requirements concerning a building factor so vital to the safety of pupils.

The provisions of the Building Exits Code of the National Fire Protection Association as it relates to the number of exit doors are as follows:

- a. One unit of door width for each unit of stairs from the upper floor.
- b. One additional unit of door width for each unit of required stairs from basement.
- c. One additional unit of door width for each 4,000 sq. ft. or fraction thereof of gross area of first floor.
- d. One additional unit of door width for each 600 sq. ft. or fraction thereof of floor area of auditoriums and gymnasiums on the first floor.

Although three states specify that this formula shall be used, nevertheless, two of these states make exceptions to some of the specific standards.

In the instance of requirement (c), Connecticut makes it optional as to whether the requirement be four thousand square feet of floor area or one hundred occupants. Virginia establishes this particular requirement as five thousand square feet and the requirement in (d) is relaxed from six hundred to nine hundred square feet.

The need for the adoption of adequate minimum requirements relating to number of school building exits is obvious.

Exit Doors

The National Council has advanced four recommendations concerning the kinds and equipment of exit doors.

3. That single leaf doors be used whenever possible, and that when double doors are to be used, a center mullion be provided.

Few states have requirements of this nature. Only Idaho recommends single leaf doors. Delaware and West Virginia specify that only double doors may be used, and Virginia requires that a center mullion be provided where more than single leaf doors are employed.

It is apparent that this is a detail of construction to which little importance is attached by those responsible for state requirements.

4. That exit doors be provided with antipanic locks.

Since antipanic locks can be installed only on doors that swing out, it should probably be noted here that Arizona and Kansas require that all doors swing out but require antipanic locks only on buildings of more than four rooms, and Missouri only on buildings of more than one room.

The following states have requirements identical with the recommendation.

- | | |
|----------------|-------------------|
| 1. Alabama | 12. Michigan |
| 2. California | 13. Nebraska |
| 3. Colorado | 14. New Jersey |
| 4. Connecticut | 15. North Dakota |
| 5. Delaware | 16. Ohio |
| 6. Florida | 17. Pennsylvania |
| 7. Idaho | 18. Vermont |
| 8. Illinois | 19. Virginia |
| 9. Kentucky | 20. West Virginia |
| 10. Maine | 21. Wisconsin |
| 11. Maryland | |

5. That unit width of door openings be twenty-two inches, but forty-inch doorways may be rated as two units.

Idaho and Virginia have requirements identical to this.

Connecticut specifies twenty-four and forty-two inches. California specifies twenty-two inches per unit width. No other states have similar requirements.

6. That the minimum width of any single-exit doorway be 36 inches, which, however, will be counted as one unit of width only; multiple exit doors and those from service quarters may be reduced to 30 inches and that each such door will be counted as one unit of width.

Twelve states have requirements concerning minimum width for doors but few of them distinguish between single and double exit doorways.

Following are the state requirements in brief form:

1. California--not less than 30 inches.
2. Connecticut--same.
3. Delaware--36 inches.
4. Idaho--same.
5. Maryland--two 36-inch doors.
6. Massachusetts--42 inches if building has more than two rooms, otherwise, 36 inches.
7. North Dakota--not less than 48 inches.
8. Ohio--minimum of 36 inches and maximum of 48 inches for single doorway; maximum of 72 inches for double doorway.
9. Pennsylvania--minimum of 60 inches for single doorway and 72 inches for double doorway.
10. Virginia--same.
11. West Virginia--36 inches.
12. Wisconsin--Minimum of 36 inches for elementary schools and 40 inches for high schools; maximum width 42 inches.

It may be observed in a few instances that the minimum requirements in the states exceed the recommended minimum. Only five states have provisions relating specifically to double doorways.

Location

Another important safety factor is the location of stairways and exits in relation to classrooms. The National Council has recommended the following standard.

7. That units be located so that at least one stairway or exit will be within 100 ft. of the corridor-exit door of

every classroom.

Only nine states have regulations of this kind.

1. California--125 ft.
2. Connecticut--same.
3. Delaware--same.
4. Idaho--same.
5. Maryland--(see below)
6. Michigan--same.
7. Pennsylvania--same.
8. South Carolina--same.
9. Virginia--same.

All requirements are identical to the recommendation of the National Council except those in effect in California and in Maryland. In the latter instance, it is required that each stairway or exit serve not more than four rooms on each side of the corridor if the building is not more than two stories in height, and not more than three rooms on each side of the corridor if the building is more than two stories. This requirement does not vary greatly from the one hundred foot maximum specified in the recommendation.

Outside Steps

8. That in climates where severe weather conditions may be expected, outside steps be discouraged or reduced to a minimum.

Twelve states have requirements relating to outside steps though several are of somewhat different nature than the recommendation. These differences may be noted in the tabulation below.

1. Alabama--recessed or weather protected.
2. Arkansas--risers 6 inches, treads 13 inches, slightly graded to front.
3. Connecticut--same.
4. Delaware--same--preferably non-exposed; risers 7 inches, tread 12 inches.
5. Florida--same.
6. Idaho--same.
7. Kentucky--same.
8. Maryland--same--not higher than 4 ft. above grade; top step or landing at least 3 ft. wide.

9. New York--risers 6 inches, treads 13 inches.
10. Pennsylvania--same--width as great as the exit served; not more than 10 steps per run, pitch or rake not more than 33°.
11. Virginia--recessed or covered.
12. West Virginia--same--risers 6 inches, treads 12 inches.

The requirements of four states are the same as the recommendation of the National Council. Four other states have this same requirement with additional specifications. The requirements in Alabama and Virginia are no doubt designed to eliminate the same hazard, or to provide for a similar safety measure as that intended by the recommendation. In Arkansas and New York, the requirements are of a different nature.

Summary

Requirements relating to only two aspects of corridor construction, namely, the establishment of minimum widths and those concerned with specifications for corridor doors into stair enclosures, are found in sufficient numbers to be significant.

The minimum widths required are in general equal to that recommended by the National Council and are quite uniform. Two states require increasing minimums with increased size of the building. Pennsylvania has established varying requirements depending on the fire rating of the building as well as its size defined in terms of pupil capacity. This seems a reasonable procedure in the light of safety as well as providing reasonable flexibility for routing traffic.

Only nine states specify that corridor doors opening into stair enclosures be of construction equal to Class B doors as defined by the Underwriters' Laboratories, which is the recommendation of the National Council. Thirteen states require only that such doors swing with exit travel.

This common deficiency plus the fact that few states have requirements corresponding to the several other recommendations of the National Council makes clear the fact that few states have established standards acceptable in the light of reasonable safety practice, and equal to that recommended by the National Council.

Not only is there a considerable variation in the number of states having requirements corresponding to the several items or aspects of stairway construction, but there is a considerable variation in the standards established by the requirements in these states.

Of the twenty-three states with requirements specifying the number of stairways for buildings of two or more stories, only four fail to require at least two. However, only five states have requirements that go beyond this minimum of two irrespective of the size of the buildings, and only two states require that the number of stairways and exits be determined by the Building Exit formula of the National Fire Protective Association. In all other states the standards established fail to meet the recommendation. This is a serious situation, particularly in light of the extreme importance of this aspect of construction to pupil safety.

The seriousness of this situation is accentuated by the fact that only twelve states have requirements specifying the kind of material to be employed in stair construction, and only four of the twelve states require that incombustible material be used as is recommended by the National Council. One additional state has a similar requirement for all buildings of more than two stories. It is clear that requirements in most instances are dangerously inadequate.

In light of the above, it is astonishing to find that requirements establishing specifications for width of stairways, runs, risers and treads, landings, handrails, and other details of construction are more frequently found. It is difficult to explain why requirements for such details of construction are established while materials that are not incombustible and an inadequate number of stairways are tolerated.

Few states require construction equal to that recommended by the National Council. This is due to both an insufficient number of requirements and to lack of sufficiently high specifications where requirements exist.

Minimum requirements corresponding to the recommendations of the National Council are infrequently found other than those requiring at least two exits and those specifying that anti-panic locks be provided on all exit doors.

While sixteen states have requirements specifying at

least two exits for buildings of particular size or type, it should be noted that only eleven of this total number require two exits for all buildings. It would seem that this latter is not an unreasonable requirement even for the one room school. While seven states have further requirements relating to the minimum number of exits only three states specify that the provisions recommended by the National Fire Protection Association in its current Building-Exits Code as is recommended by the National Council be followed.

It is evident that not only is there need for more states to establish adequate minimum requirements, but that those states with minimum requirements need to upgrade them if adequate standards of safety are to be insured.

The only other requirement found in significant number prescribes the use of anti-panic locks on exit doors. Twenty-four states have requirements of this kind.

Few requirements are found regulating the location of exit or width of exit door, both factors of great importance in insuring safety to building occupants. Even where requirements exist, standards established by them are usually lower than those established by the recommendations of the National Council. This is a serious lack in light of the obvious importance of exits as a safety factor.

As has been noted in this chapter, the National Council recommends the specifications formulated by the National Fire Protection Association relating to both number of stairways and number of exits. The Building Exits Code of the National Fire Protection Association contains a chapter outlining the fundamental requirements necessary for reasonable safety to the life of the occupants of school buildings. The code recommendations are based upon the opinion that the material of building construction, while important, is less significant than factors of design and arrangement. A building can be constructed of fire-proof materials and still present a considerable life hazard if open stairways permit the rapid spread of fire, or even smoke, and if exits are inadequate. The hazard of smoke may be more important than that of fire itself, inasmuch as the Association maintains that more fire deaths are due to the effects of smoke than to actual burns. Even a slight amount of smoke may cause a severe panic and if either stairways or exits are inadequate,

loss of life may result.

It is obvious that the stairway and exit requirements in effect in many states do not provide adequate standards of safety. This coupled with the fact still more states are without requirements of any nature, presents a serious if not alarming situation. It is to be earnestly hoped that the standards employed in actual construction may exceed the minimum requirements in all such instances.

CHAPTER V

SANITARY FACILITIES

The National Council on Schoolhouse Construction has adopted recommendations relating to the planning and installation of four kinds of sanitary facilities, all of which are highly desirable in a modern school of several rooms, and two of which are essential in any school. These four sanitary facilities are:

1. Toilets
2. Drinking fountains
3. Service sinks
4. Showers

A total of thirty-two recommendations have been formulated by the National Council relating to these facilities.

Toilets

Nineteen of the thirty-two recommendations are concerned with the location of toilet rooms, construction of such rooms, fixtures, and washbasins.

Table 9 shows requirements by states corresponding to each of the nineteen recommendations of the National Council governing toilet rooms and fixtures.

An analysis of Table 9, made by reading down, shows that requirements are infrequently found corresponding to many of the recommendations. Minimum requirements are most numerous concerning the following four aspects or factors of construction.

- a. Number of closet fixtures--sixteen requirements
- b. Number of urinals--thirteen requirements
- c. Window area--eleven requirements
- d. Vented separately--ten requirements
- e. Number of washbasins--ten requirements

Table 9, reading from left to right, shows that only two states, Connecticut and Virginia, have a sufficient number of regulations or requirements to constitute codes that might be

TABLE 9

STATES HAVING REQUIREMENTS CONCERNING TOILETS CORRESPONDING TO THE
RECOMMENDATIONS OF THE NATIONAL COUNCIL

States	Recommendations of the National Council by Number*																			Total
	Location		Construction			Toilet Fixtures				Washbasins										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19		
California....	.	.	.	.	.	x	.	.	.	x	x	x	.	.	x	.	.	.	.	4
Colorado.....	.	.	.	.	.	.	.	.	x	x	x	x	.	.	.	.	.	.	.	2
Connecticut..	x	x	.	x	.	x	x	.	.	.	x	x	x	x	x	x	.	.	.	17
Delaware.....	.	.	x	x	.	.	.	.	.	.	x	x	.	.	.	.	.	.	.	7
Idaho.....	.	.	x	x	.	x	.	.	.	.	x	x	.	.	.	.	.	.	.	7
Kentucky.....	.	.	x	.	.	x	.	.	x	x	x	x	.	.	.	.	.	.	.	6
Maine.....	.	.	.	.	.	.	.	.	.	.	x	.	x	.	.	.	.	.	.	3
Maryland.....	x	.	x	.	.	x	.	.	.	x	x	x	.	.	.	.	.	.	.	6
Massachusetts	.	.	x	.	.	x	.	.	.	.	x	x	.	.	.	.	.	.	.	5
Michigan.....	.	.	.	.	.	.	.	.	.	.	x	x	.	.	.	.	.	.	.	4
New Jersey...	.	.	x	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	3
New York.....	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
North Dakota..	.	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Ohio.....	x	.	.	.	.	x	.	.	.	x	x	x	.	.	.	.	.	.	.	6
Pennsylvania..	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Vermont.....	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Virginia.....	.	x	x	.	x	.	.	x	.	.	.	.	x	x	.	.	.	.	.	19
West Virginia	x	.	.	.	.	x	.	.	.	.	.	.	.	.	.	.	.	.	.	5
Wisconsin.....	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
Total.....	7	2	10	8	1	11	2	2	4	4	16	13	4	2	10	2	2	2	2	...

*1. Located on classroom floors (p. 73); 2. Separate toilets for kindergarten and primary rooms (p. 73); 3. Vented separately (p. 73); 4. Floor and wall finish (p. 74); 5. Partitions (p. 74); 6. Window area (p. 75); 7. Material in bowls (p. 75); 8. Type of bowl (p. 75); 9. Specifications for seats (p. 75); 10. Height of fixtures (p. 76); 11. Number of closets based on enrollment (p. 76); 12. Number of urinals based on enrollment (p. 78); 13. Material in urinals (p. 79); 14. Hose faucet (p. 79); 15. Number of washbasins (p. 79); 16. Material in basins (p. 80); 17. Mirrors (p. 80); 18. Height of basins (p. 80); 19. Soap dispensers (p. 80).

termed complete or even adequate. This neglect on the part of other states may be explained by the adequacy of local ordinances governing plumbing. However, this explanation is subject to considerable doubt in the light of Mr. Sahlstrom's study,¹ in which he reports that in 1931 there were a total of five hundred cities with a population of over five thousand with no local building ordinances.

The same procedure heretofore employed in tabulating requirements in the several states and comparing the requirements with the recommendations of the National Council is used.

Location

1. That toilet rooms be located on classroom floors and that basement toilets except as adjuncts to special activities be discouraged.

Seven states have requirements of this kind:

1. Connecticut--same.
2. Maryland--in larger buildings.
3. Massachusetts--prohibited if the basement floor level is more than 3 ft. 6 inches below grade.
4. New York--same.
5. Ohio--same--if the building is more than 3 stories.
6. Virginia--same.
7. West Virginia--same.

2. That toilet rooms in connection with kindergartens or first primary rooms be provided in close proximity to the rooms occupied by such pupils.

Connecticut and Virginia are the only states with requirements of this kind.

The few states requiring that toilets be placed on classroom floors and that special toilets be provided for and in close proximity to kindergartens and primary rooms apparently indicates that such practices are not considered highly essential.

Construction

3. That toilet rooms be vented separately from the gen-

¹John W. Sahlstrom, Some Code Controls of School Building Construction in American Cities. New York: Bureau of Publications. Teachers College, Columbia University, 1933.

eral ventilation system.

1. Connecticut--same--separate additional vents in addition to toilet vents.
2. Delaware--same--8 changes of air per hour required.
3. Idaho--same.
4. Kentucky--same.
5. Maryland--same.
6. Massachusetts--same.
7. New Jersey--same.
8. New York--same.
9. Texas--same.
10. Virginia--same.

It is possible that the need for such a requirement is not generally felt either because such construction is almost universal or because such a requirement is usual in state and local plumbing ordinances.

It is unlikely that any state does not have a state plumbing code governing the installation of plumbing in all construction. Such codes, probably without exception, include provision for separate venting of toilet rooms. Such a provision in the general code makes the inclusion of a similar requirement in the schoolhouse code unnecessary.

4. That (a) floors and walls be finished in impervious materials, permitting washing down and that (b) all internal corners be coved.

The second provision in this recommendation (b) is almost entirely neglected in the state requirements. Therefore, the following tabulation is based only on the first provision (a).

1. Connecticut--same.
 2. Delaware--same, excepting walls to a height of 5 ft. only.
 3. Idaho--same, excepting wainscot rather than entire walls.
 4. Massachusetts--same, excepting wall bases to a height of 6 inches only.
 5. Michigan--floors only.
 6. New Jersey--floors within 3 ft. of fixtures.
 7. Ohio--same, excepting wall bases to a height of 6 inches only.
 8. Virginia--same. Floor drain also required.
5. That toilet partitions be of impervious material.

Virginia is the only state with a requirement specifying the use of such material in toilet partitions.

6. That each toilet room for pupils be provided with windows having glass area not less than one-twelfth of floor area.

Requirements relating to windows in toilets are in effect in a total of ten states, not always, however, are they as specific as the recommendations of the National Council.

1. California--one-eighth of floor area.
2. Connecticut--one-tenth of floor area.
3. Idaho--one-tenth of floor area.
4. Kentucky--one-tenth of floor area.
5. Maryland--exterior windows required.
6. Massachusetts--suitably lighted from the outside.
7. New Jersey--one-tenth of floor area.
8. North Dakota--outside windows required.
9. Ohio--one-tenth of floor area.
10. Virginia--same (one-twelfth).
11. West Virginia--one-fifth of floor area.

It may be noted that where specific requirements are in effect, the required window area specified is somewhat larger than that recommended. West Virginia with a required area of one-fifth departs widely from the usual requirement of one-tenth.

Fixtures

7. That watercloset bowls be of vitreous china.

But two states, Connecticut and Virginia, have requirements similar to this recommendation. Connecticut, however, stipulates either vitreous china or porcelain.

8. That water closet bowls be of the extended lip or elongated rim type.

Here again, only the two states, Connecticut and Virginia, have requirements specifying this type of equipment.

9. That toilet seats be of impervious materials with open fronts.

Four states only have requirements of this kind, Connecticut, Delaware, Idaho, and Virginia. All of these four states require seats with open fronts but only Virginia specifies that they be of impervious material.

10. That the top of water closet rims be of varying heights as follows: For children in the elementary grades approximately 10 inches; for junior and senior high school pupils approximately 13 inches.

Only four states have requirements relating to this factor.

1. Connecticut--Elementary, 13 inches--junior and senior high school, standard.
2. Kentucky--Smaller size for elementary schools--junior and senior high school, standard.
3. Ohio--Juvenile or short closets for primary and grade schools.
4. Virginia--Not more than 13 inches.

The following recommendation relates to the number of closets to be installed in relation to enrollment.

11. That not less than one water closet be provided for every 25 girls and one for every 40 boys based on the working capacity of the building.

Sixteen states have requirements of this kind. In a number of instances, tables are presented to show varying ratios depending on the enrollment. It is not uncommon to find a lower ratio of closets per pupil for small enrollments, with increasing ratios as the enrollment increases. There is no uniformity in these tables or the enrollment classifications set up. In a few states, different requirements are established for elementary schools and high schools. It is clear that some uniform procedure is needed to establish a basis to make the data from these states comparable. Consequently, the requirements for both the minimum enrollments and maximum were selected. These were equated in terms of the number of pupils per closet fixture. In every state but one, New York, minimum requirements were established for both girls and boys. The following tabulation shows these requirements by states.

	<u>Girls</u>	<u>Boys</u>
1. California.....	1--25	1--75
2. Colorado.....	1--15	1--20
3. Connecticut....	El. 1--18 to 1--20 H.S. 1--20 to 1--30	1--50 to 1--70 1--50 to 1--70
4. Delaware.....	1--30 (plus 1 additional closet per toilet room)	1--50

	<u>Girls</u>	<u>Boys</u>
5. Idaho.....	1--20	1--33
6. Kentucky.....	El. 1--25 H.S. 1--30	1--30 1--40
7. Maine.....	1--15 to 1--30	1--20 to 1--40
8. Maryland.....	1--20 to 1--24	1--30 to 1--36
9. Massachusetts..	1--17 to 1--42	1--25 to 1--70
10. Michigan.....	1--15 to 1--20	1--20 to 1--30
11. New York.....	1--25	1--25
12. Ohio.....	1--12 to 1--34	1--25 to 1--62
13. Pennsylvania...	1 per classroom (if more than 6 classrooms a 20% reduction is permitted)	1 per 2 classrooms
14. Virginia.....	El. 1--35 H.S. 1--45 Consolidated 1--40	1--50 1--60 1--55
15. West Virginia..	1--14 to 1--34	1--25 to 1--60
16. Wisconsin.....	El. and Jr. H.S. 1--25 Sr. H.S. 1--30	1--50 1--60

The foregoing tabulation shows large variations in the minimum number of fixtures required in schools of both small and large enrollments within the same states. In twenty-three instances, requirements permit a higher ratio, particularly for schools with large enrollments, than that set up in the recommendation of the National Council. Eleven are found in requirements for girls and twelve in requirements for boys. It may be further noted that in the case of girls, the minimum requirements, particularly for schools with small enrollments, are more rigid than the recommendation. In ten states, the same situation prevails in the closet requirements for boys.

Large variations from state to state may be noted, ranging in case of girls from one to twelve to one to thirty-five for elementary schools of small enrollments, and from one to fifteen to one to forty-two for elementary schools with large enrollments. Even larger variations are found in the closet requirements for boys, ranging from one to twenty to one to seventy-five.

Such wide variation indicates the need for greater standardization in these requirements. This need is accentuated by two factors; first, the necessity of an adequate number of closets, and second, the effect of such great variation on building costs.

Urinals

Directly related to the number of closets required for boys is the number of urinals required. The National Council makes the following recommendation.

12. That not less than one urinal be provided for every 40 boys, based on the working capacity of the building.

All states except three with requirements concerning the number of closets have requirements specifying the number of urinals. These exceptions are Colorado, Maine, and New York.

- | | |
|---------------------|---|
| 1. California..... | 1--37 |
| 2. Connecticut.... | El. 1--25 to 1--30
H.S. 1--30 to 1--42 |
| 3. Delaware..... | 1--30 |
| 4. Idaho..... | 1--15 |
| 5. Kentucky..... | El. 1--20
H.S. 1--25 |
| 6. Maryland..... | 1--30 to 1--36 |
| 7. Massachusetts.. | 1--25 to 1--45 |
| 8. Michigan..... | 1--30 to 1--40 |
| 9. Ohio..... | 1--17 to 1--42 |
| 10. Pennsylvania... | (3 urinals may be substituted
for 2 closets) |
| 11. Virginia..... | El. 1--30
H.S. 1--35
Consolidated 1--30 |
| 12. West Virginia.. | 1--20 to 1--42 |
| 13. Wisconsin..... | El.
and Jr. H.S. 1--25
Sr. H.S. 1--30 |

While more uniformity prevails among these requirements than among the requirements regulating the number of closets, there are still rather wide variations. This range is from one to fifteen to one to thirty-five in the case of schools with small enrollments, and one to fifteen to one to forty among schools with large enrollments. It is significant that in only three instances are the state requirements less rigid than the recommendation of the National Council. In general, the state requirements are higher or more rigid than the recommendation. Whether this is desirable or wasteful is questionable, particularly in light of the relationship of this factor to building costs.

13. That urinals be of vitreous china, wall type, and provided with automatic flushing devices.

Only the four following states have requirements or specifications relating to this equipment.

1. Connecticut--same, excepting porcelain may be substituted for vitreous china.
2. Delaware--same, excepting automatic flushing device is not required.
3. Maine--only requirement is full length type of fixture.
4. Virginia--same, excepting automatic flushing device is not required.

14. That a hose faucet be provided in every toilet room.

Only Connecticut and Virginia have such requirements in effect.

Washbasins

Five recommendations concerned with the kinds of washbasins, their installations and accessories have been formulated by the National Council.

15. That washbasins be provided in or adjacent to all toilet rooms in the ratio of one to every two fixtures.

The following ten states have requirements concerning the number to be installed.

1. California--same.
2. Connecticut--1--50 pupils in Elementary Schools.
1--60 pupils in High Schools
3. Delaware--1 to 50 pupils.
4. Idaho--1 to 100 pupils.
5. Kentucky--1 to every 3 fixtures.
6. Maryland--1 to 45 pupils. If enrollment is more than 500 a reduction of 20 % is permitted.
7. Michigan--1 to every 3 fixtures.
8. Virginia--1 to 60 in Elementary and Consolidates Schools and 1 to 50 pupils in High Schools.
9. West Virginia--1 to 50 pupils.
10. Wisconsin--same.

It is impossible to make any meaningful comparison of these requirements inasmuch as the standards are in some instances in terms of basins per pupil, and in others, basins per toilet fixture. Inasmuch as the ratio of toilet fixtures per

pupil varies widely in the several states, there must of necessity likewise be wide variations from state to state in the ratios of basins per pupil. Again there seems to be need for a generally uniform standard.

Only Connecticut and Virginia have requirements corresponding to the following four recommendations. Inasmuch as the requirements in both states are identical with each of the four recommendations with one exception, noted below, the usual tabulations have been omitted following the National Council recommendations.

16. That washbasins be of vitreous china, enamelled iron, or noncorrosive materials with backs and aprons. That they be provided with hot and cold water.

17. That mirrors be provided but installed so as not to interfere with the use of washbasins.

18. That washbasins be installed 25 inches from the floor for elementary grades and 30 inches for high schools.

Connecticut specifies twenty inches from the floor for elementary schools.

19. That soap dispensers be provided in connection with washbasins.

Drinking Fountains

Few states have requirements concerning drinking fountains. Very few specifications are in effect regulating the type of drinking fountains and their installations. A number of the requirements are so general that they fail to establish any usable standards. The National Council, however, has formulated a list of six recommendations relating to drinking fountains.

Table 10 shows the requirements corresponding to the recommendations in effect in each state.

A total of eleven states have requirements relating to drinking fountains. Among these eleven states only two, Connecticut and Virginia, have requirements corresponding to more than three of the recommendations of the National Council. Both of these states have requirements corresponding to all of the six recommendations of the National Council.

1. That adequate drinking fountains be provided in the ratio of one to every 100 pupils, but not less than one to each floor, to be located in corridors, properly recessed. Said

recess to be not less than 30 inches wide.

TABLE 10

STATES HAVING REQUIREMENTS CONCERNING DRINKING FOUNTAINS
CORRESPONDING TO THE RECOMMENDATIONS
OF THE NATIONAL COUNCIL

States	Recommendations of the National Council by Number*						Total
	1	2	3	4	5	6	
Alabama.....	x	.	.	.	.	.	1
California...	x	.	.	.	.	.	1
Colorado.....	x	.	.	.	.	.	1
Connecticut..	x	x	x	x	x	x	6
Delaware.....	x	x	.	.	.	x	3
Idaho.....	x	.	.	x	.	x	3
Kentucky.....	x	x	.	.	.	.	2
Maryland.....	x	.	.	.	x	x	3
Ohio.....	x	.	.	.	.	.	1
Virginia.....	x	x	x	x	x	x	6
Wisconsin....	x	.	.	.	.	.	1
Total.....	11	4	2	3	3	5	...

*1. Number based on enrollment (p. 80); 2. Sanitary type (p. 82); 3. Height (p. 82); 4. For special rooms (p. 82); 5. For playgrounds (p. 82); 6. Prohibited in toilet rooms (p. 82).

The following eleven states have requirements concerning one or more of the provisions contained in this first recommendation.

1. California--at least one for each floor.
2. Alabama--safe drinking fountains.
3. Colorado--adequate drinking facilities.
4. Connecticut--same, ratio of 1 to 60 in small schools; 1 to 100 in large schools.
5. Delaware--ratio of 1 to 75.
6. Idaho--ratio of 1 per 75-100 pupils, not necessarily recessed.
7. Kentucky--same, except no regulation as to number.
8. Maryland--recessed in corridors.
9. Ohio--1 for each 6,000 sq. ft. of floor area in the superstructure, and in the basement 1 for each 350 pupils of each sex.
10. Virginia--same, not necessarily recessed.

11. Wisconsin--1 for each 6,000 sq. ft. of floor area per story and in basement

It may be noted that these specifications are too frequently incomplete and lacking in detail. They vary so greatly that it is impossible to make useful comparison or formulate any generalizations.

2. That drinking fountains be of the sanitary type.

Specific requirements of this kind relating to drinking fountains are found only in the following four states: 1. Connecticut, 2. Delaware, 3. Kentucky, and 4. Virginia.

It is possible that other states have omitted such requirements because of the fact that running water is not always available in rural areas, and such minimum requirements could not be met where this situation prevails.

3. That fountains be installed so as to best serve children. Approximate height, twenty-eight inches for elementary pupils and thirty-six inches for high school students.

Only two states have requirements specifying height of fountains.

1. Connecticut--23 inches for elementary schools;
25 inches for high schools.

2. Virginia--same.

4. That fountains be provided in kindergartens, gymnasiums, playrooms, and cafeterias.

Only three states include like provisions, Connecticut, Idaho, and Virginia.

5. That drinking fountains be provided on playgrounds.

Three states, Connecticut, Maryland, and Virginia have such requirements.

6. That no drinking fountains be installed in toilet rooms.

The following five states have requirements identical to this recommendation: Connecticut, Delaware, Idaho, Maryland, and Virginia.

Not only do few states have requirements relating to drinking fountains, but where requirements are found they are so brief and lacking in detail as to have little value. Only six states have established requirements as to the number of fountains, which would be the most fundamental and necessary requirement. Of these six, only four specify a ratio in terms of foun-

tains per pupil. The need for requirements for such an important sanitary service is obvious.

Service Sinks

The National Council has formulated three recommendations relating to the installation of service sinks. However, only three states have requirements concerning such sinks.

1. That large slop sinks with hot and cold water be provided for janitors' use.

1. Connecticut--1 for each 6,000 sq. ft. or fraction thereof of floor area.
2. Ohio--1 for each 6,000 sq. ft. or fraction thereof of floor area.

2. That each laboratory be provided with adequate sink facilities of a number and type to meet the instructional needs.

1. Connecticut--same.
2. Idaho--same.

3. That all shops, home economics rooms,,etc., be provided with wash sinks of acid resisting ware.

1. Connecticut--"acid-resisting" not specified.
2. Idaho--same.

Showers

The fourth kind of sanitary facility for which recommendations are made by the National Council is showers.

Again as with service sinks, it is found that few states have minimum requirements and no state has requirements corresponding to more than two of the recommendations.

1. That shower rooms of ample size be provided in connection with gymnasiums and that they be specially ventilated.

1. Connecticut--1 head for each 4 pupils in one gymnasium class--special ventilation not required.
2. Delaware--special ventilation not required.
3. Idaho--special ventilation not required.
4. Kentucky--special ventilation not required.
5. Massachusetts--1 shower per 10 users--special ventilation not required.

2. That all shower spaces be provided with floors, walls,

partitions, etc., of durable impervious materials.

1. Idaho--same.

No states have adopted requirements corresponding to the specifications contained in the following two recommendations.

3. That floors be of nonslip character and properly sloped for drainage.

4. That all shower heads be very substantially installed and provided with non-scalding mixing valves. For large installations, a master valve is suggested.

It may be noted that while minimum requirements concerning all sanitary facilities are in force in only a relatively small number of states, that requirements concerning service sinks and showers are almost negligible. Inasmuch as both the necessity of adequate sanitary facilities and their direct relationship to building costs are so evident, it is surprising to find that so few states have requirements or specifications concerning them.

Summary

It is interesting to note that out of a total of nineteen states with requirements concerning toilets, only seven states require that they be located on classroom floors. This is a serious deficiency first, because of inadequate natural lighting in basement toilet rooms, and second, because of inconvenience and difficulty of supervision. While basement toilets are still common throughout this country, there is reason to believe that current practice in this respect has advanced beyond requirements.

Few states require either separate venting or that floors, walls, and partitions be of impervious materials. Here again there is reason to believe that current practice may approach the recommendations of the National Council even though requirements are lacking.

Only nine states have requirements specifying the amount of window area. While the recommendation of the National Council establishes a ratio of window area to floor area of one-twelfth, the usual state requirement is one-tenth. West Virginia requires a ratio of one-fifth. This latter requirement is undoubtedly unreasonable and would be almost impossible to attain without a considerable increase in the size of toilet room and probably un-

warranted building cost.

Almost no requirements are to be found relating to fixtures except those specifying the minimum number. As has been pointed out wide variations exist in the number of both closets and urinals required. Within a particular state, requirements for both high schools and elementary schools are not unusual. Still more common are requirements varying with the size of the building. In general, requirements are less rigid for schools of large enrollments than is the recommendation of the National Council. The National Council recommendation provides for no variation for either the enrollment or the type of school.

The question of how all of these standards were established may be properly raised in the interests of providing both adequate facilities and justifiable costs. Practically no studies have been made, and ratios established apparently represent the subjective opinions of school people and architects. The National Committee on School Plant Research made a time study of toilet room facilities in twenty elementary and high schools distributed over the country. These were largely located in large cities. From the results obtained a recommendation based on the maximum utilization of toilets was made. This recommendation called for a considerable reduction in the number of units in proportion to school population. The following ratios were recommended:

<u>Toilet Units</u>	<u>Ratio</u>
Girls	
Elementary.....	1:35
High School.....	1:40
Boys	
Elementary and High School...	1:50
Urinals.....	1:60
Lavatories	
Elementary.....	1:60
High School.....	1:100

In small schools of less than one hundred pupil enrollment, a minimum of two toilet units for each sex was recommended.¹

It should be noted that the number of pupils per unit shows a considerable increase over the National Council's recom-

¹National Council on Schoolhouse Construction Proceedings, p. 24. Nashville, Tennessee: George Peabody College, 1942.

mendation. While the ratio varies for elementary and high schools it does not vary with the building enrollment. The need for further and more comprehensive time studies for buildings of various sizes is evident before justifiable standards may be established. Until such are established it is impossible to criticize those state requirements which are less rigid than the recommendations of the National Council.

Few states have requirements specifying the number of washbasins. Even in this feature wide variations may be noted. Some are in terms of pupil ratios and others in toilet fixture ratios. It is again apparent that standards have not been established by any scientific procedure but are the results of subjective judgment.

CHAPTER VI

SERVICE SYSTEMS AND SERVICE ROOMS

The National Council on Schoolhouse Construction has formulated a list of seventeen recommendations concerning five kinds of service systems, namely: general water supply, heating, ventilation, electric service, and public address system.

Six recommendations are made concerning two kinds of service rooms, boiler or heater rooms, and service rooms for janitors. State requirements corresponding to certain of the recommendations have frequently been adopted. In other instances, there are few or even no requirements corresponding to some of the recommendations.

Table 11 shows the states with requirements corresponding to the recommendations of the National Council on Schoolhouse Construction.

Cursory examination of this table shows that requirements corresponding to most of the recommendations are few in number. Not more than eight states have requirements in effect corresponding to any other of the recommendations than the five listed directly below.

<u>Recommendations</u>	<u>Number of States Having Requirements</u>
6. Heating	18
9. Ventilation.....	25
10. Code requirements for wiring...	11
19. Fireproof boiler rooms.....	18
21. Fireproof fuel rooms.....	11

Requirements corresponding to the five recommendations making general provisions for services are more common than those specifying details of construction.

In reading Table 11 from left to right, it is seen that few states have requirements corresponding to many of the twenty-three recommendations of the National Council. Connecticut with

TABLE 11

STATES HAVING REQUIREMENTS CONCERNING SERVICE SYSTEMS AND
SERVICE ROOMS CORRESPONDING TO THE RECOMMENDATIONS
OF THE NATIONAL COUNCIL

States	Recommendations of the National Council by Number*												
	General Water Supply					Heating			Ven- tila- tion	Electric Service			
	1	2	3	4	5	6	7	8	9	10	11	12	13
Alabama.....	x	.	.	.	.	x	.	.	x	x	.	.	.
California.....	.	.	.	.	.	.	.	.	x	.	.	.	.
Colorado.....	.	.	.	.	.	x	.	.	x	x	.	.	.
Connecticut...	x	x	.	.	.	x	x	x	x	x	x	.	.
Delaware.....	.	.	.	.	.	x	.	.	x	x	.	.	.
Florida.....	.	.	.	.	.	.	.	.	x	x	.	.	.
Idaho.....	x	x	.	.	.	x	.	.	x	.	.	x	.
Illinois.....	.	.	.	.	.	.	.	.	.	x	.	.	.
Indiana.....	.	.	.	.	.	x	.	.	x	.	.	.	.
Kentucky.....	x	.	.	.	x	x	.	.	x	x	.	.	.
Maine.....	.	.	.	.	.	x	.	.	x	.	.	.	.
Maryland.....	.	.	.	.	x	.	x	x	x	x	.	.	.
Massachusetts.	.	.	.	.	.	x	.	.	x	x	.	.	.
Michigan.....	x	x	.	.	.	x	.	.	x	.	.	.	.
Montana.....	.	.	.	.	.	x	.	.	x	.	.	.	.
New Jersey....	.	.	.	.	.	x	.	.	x	.	.	.	.
New York.....	.	.	.	.	.	x	.	.	x	.	.	.	.
North Dakota..	.	.	.	.	.	x	.	.	x	.	.	.	.
Ohio.....	x	.	.	.	.	x	.	.	x	x	.	.	.
Oklahoma.....	.	.	.	.	.	.	.	.	x	.	.	.	.
Pennsylvania..	x	x	.	.	.	.	.	.	.	.	.	x	.
South Carolina	.	.	.	.	.	.	.	.	x	.	x	.	.
South Dakota..	.	.	.	.	.	x	.	.	x	.	.	.	.
Texas.....	.	.	.	.	.	.	x	.	x	.	.	.	.
Vermont.....	x	.	.	.	.	x	x	.	x	.	.	.	.
Virginia.....	.	.	.	.	x	.	.	.	x	x	x	.	.
Wisconsin.....	.	.	.	.	.	x	x	.	x	.	.	.	.
Total.....	8	4	0	0	3	18	5	2	25	11	3	2	0

*1. Ample water supply (p. 90); 2. Ample supply of hot water (p. 90); 3. Pipes of non-corrosive materials (p. 91); 4. Exposed pipes insulated (p. 91); 5. Pipes to drinking fountains (p. 91); 6. Heating (p. 91); 7. Automatic temperature control (p. 92); 8. Heating of special units (p. 92); 9. Ventilation (p. 93); 10. Code requirements for electric wiring (p. 95); 11. Adequate outlets (p. 96); 12. Adequate capacity for service connections (p. 96); 13. Adequate capacity for stage feeders (p. 96); 14. Public address system (p. 97); 15. Microphone and loud-speaker (p. 97); 16. Speakers in instructional rooms (p. 97); 17. Radio receiver (p. 97); 18. Adequate boiler and heater room (p. 97); 19. Fireproof construction for boiler rooms (p. 97); 20. Exits and windows in boiler rooms and fireproof construction of same (p. 98); 21. Fireproof construction of fuel room (p. 99); 22. Service rooms for janitors and engineers (p. 99); 23. Separate toilets for janitors and workmen (p. 100).

TABLE 11--Continued

Recommendations of the National Council by Number*										Total
Public Address System				Boiler and Heater Rooms				Service Rooms for Janitors & Engineers		
14	15	16	17	18	19	20	21	22	23	
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x	x	x	x	.	x	.	x	x	x	
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sixteen is the only state with more than nine such requirements. It appears that in almost all instances, state codes governing service systems are too brief and incomplete to be adequate.

The same procedure employed in previous chapters is used to summarize and list the requirements which are in effect in each state.

General Water Supply

1. That an adequate supply of water be provided, approximately one cubic foot per pupil per day.

1. Alabama--ample and safe supply.
2. Connecticut--pure supply, to be tested by the Department of Public Health.
3. Idaho--adequate supply.
4. Kentucky--adequate provisions for water supply.
5. Michigan--ample supply, preferably from a public supply system.
6. Ohio--where available.
7. Pennsylvania--safe supply, to be approved by Bureau of Sanitary Engineering, Department of Health.
8. Vermont--sufficient supply for all plumbing fixtures.

It might reasonably be expected that more than eight states would have requirements concerning a general water supply. However, lack of such requirements can be readily explained by the fact that the responsibility for insuring a safe supply of water rests with state and local boards of health. State boards of health, probably without exception, require periodic examinations of water samples from any source of supply serving the public. Inasmuch as this regulation extends to all sources of water supply it is unnecessary to include such a requirement in any code applying to a particular kind or class of construction. Approval of the water supply in any situation is mandatory.

The above tabulation also shows that no state has requirements as specific in indicating the amount of water as is the recommendation of the National Council, the usual provision requiring only an adequate or ample amount.

2. That an ample amount of hot water be made available at all devices requiring same.

Only four states have such requirements.

1. Connecticut--same.
2. Idaho--same.
3. Michigan--same.
4. Pennsylvania--sufficient for washing and bathing facilities.

3. That all concealed and all hot water pipes be of non-corrosive materials.

4. That all exposed cold water pipes in finished rooms be insulated to prevent sweating.

None of the states have requirements corresponding to either of the two last mentioned recommendations.

5. That supplies to drinking fountains be run remote from hot water pipes or heated spaces, or that they be insulated.

Requirements containing similar specifications are found in only three states, namely: Kentucky, Maryland, and Virginia.

Heating

State requirements concerning heating are of necessity general in their nature. The great variation both in size of buildings and kinds of equipment precludes detailed specifications. In no instance are the requirements as specific as is the recommendation of the National Council, the usual state requirement specifying only a system adequate to maintain a prescribed temperature.

6. That all spaces regularly occupied by pupils be so heated that a temperature of sixty-eight degrees may be consistently maintained during occupancy with due regard to proper humidity and air motion, except that gymnasiums, shops, corridors, swimming pools, etc., be given special attention as regards temperature conditions and regulation commensurate with their use.

1. Alabama--buildings of 6 rooms or more equipped with central system.
2. Colorado--healthful temperature maintained.
3. Connecticut--classrooms 70° at 10° below zero. Other rooms 60° to 70°.
4. Delaware--70° at zero.
5. Idaho--70° at 20° below zero.
6. Indiana--70°, humidity of 40 per cent.
7. Kentucky--70° at zero.
8. Maine--70°.

9. Massachusetts--classrooms 68°; corridors, toilet rooms, gymnasiums, etc., 65°; shower and dressing rooms 75°.
10. Michigan--68° at a point 4 ft. above the floor under average winter conditions.
11. Montana--70°.
12. New Jersey--70° at zero.
13. New York--70° at zero, humidity of 35 per cent.
14. North Dakota--70°.
15. Ohio--70° at zero.
16. South Dakota--70°.
17. Vermont--70°.
18. Wisconsin--classrooms 70°--72°; assembly rooms 68°--72°; gymnasiums 55°--65°; toilet rooms 65°; wardrobe and locker rooms 65°--68°; dining and lunch rooms 65°--70°; playrooms 60°--65°; auditoriums and bathrooms 75°.

As might be expected temperatures required for classrooms are quite uniform. It may be noted, however, that few states have minimum requirements for other than classrooms. Only two states, New York and Indiana, have any specific requirement for humidity.

7. That all systems wherever practicable be provided with automatic temperature control.

The following five states either specify or recommend such automatic temperature control.

1. Connecticut
2. Maryland
3. Texas
4. Vermont
5. Wisconsin

8. That special provisions be made to heat (and ventilate) administrative units, auditoriums and such rooms as will be used during times other than the regular school day.

Connecticut and Maryland are the only states with requirements for such provision.

While eighteen states have minimum requirements relating to the capacity of heating plants in terms of minimum temperatures to be maintained, only five states have further requirements or specifications concerning heating systems. As with other aspects of building or equipment, there are few requirements concerned with detail.

Ventilation

The question as to what constitutes adequate ventilation is still an open one. So little agreement is found in the literature as to acceptable standards, methods, and equipment that the National Council makes only a very general recommendation concerning ventilation, with a brief explanation accompanying it. State requirements in effect are usually much more exacting than the recommendation of the National Council, and frequently contain rather detailed specifications. In light of the lack of agreement as to adequate methods and standards of ventilation, it is interesting to find these specific and detailed requirements. The National Council's recommendation and state requirements follow.

9. That all space regularly occupied by pupils be ventilated so as to maintain healthful air conditions at all times during occupancy. (Due to constant progress and research in ventilation, the Council does not at this time make more specific recommendations.)¹

1. California--30 cu. ft. of pure air per minute.
2. Alabama--same. Fresh air to be introduced and vitiated air expelled.
3. Colorado--same.
4. Connecticut--15 cu. ft. of fresh outdoor air per pupil per minute. At least four changes per hour. At least six changes per hour in toilets, cloak and dressing rooms and in kitchens and food laboratories. Exhaust ducts required.
5. Delaware--if mechanical ventilation is required 30 cu. ft. of fresh air per pupil per minute in classrooms. In assemblies 15 cu. ft. per minute. Exhaust flues required.
6. Florida--either mechanized or cross ventilation.
7. Idaho--10 cu. ft. per pupil per minute in addition to window ventilation. Fresh air intakes required.
8. Indiana--outside foul air flues to withdraw foul air at rate of 1800 cu. ft. per hour per 225 cu. ft. of room space. Fresh air must be taken from outside the building.

¹Proceedings of the Twentieth Annual Meeting of the National Council on Schoolhouse Construction. 1942, p. 86. Tallahassee, Florida: State Department of Education, John L. Graham.

9. Kentucky--same. Mechanical ventilation not required.
10. Maine--15 cu. ft. of pure warm air per pupil per minute. Foul air ducts of same capacity. If direct radiation is used, vent stack in each classroom must have cross section area of 324 sq. in.
11. Maryland--same. At least 3 windows and foul air ducts with a cross section of at least 350 sq. in. for each standard room.
12. Massachusetts--30 cu. ft. of fresh air per minute per pupil and removal of an equal volume. Gymnasiums and assemblies 2 1/2 cu. ft. per minute for each sq. ft. of floor area. Other special rooms 1 1/2 cu. ft. per sq. ft. of floor area.
13. Michigan--same.
14. Montana--same.
15. New Jersey--30 cu. ft. of fresh air per pupil per minute.
16. New York--30 cu. ft. of fresh air per pupil per minute.
17. North Dakota--30 cu. ft. of fresh air per pupil per minute.
18. Ohio--6 air changes per hour in rooms used for instruction and in toilets. 3 air changes per hour in all other parts of building except corridors, halls, heater and fuel rooms, storage spaces, offices, rest rooms and other rooms with areas of not more than 200 sq. ft.
19. Oklahoma--30 cu. ft. of fresh air per pupil per hour.
20. South Carolina--same. One-half of the total number of windows must open for ventilation.
21. South Dakota--30 cu. ft. of fresh air per pupil per minute.
22. Texas--30 cu. ft. of fresh air per pupil per minute.
23. Vermont--30 cu. ft. of fresh air per pupil per minute. Exhaust flues required.
24. Virginia--at least 3 air changes per hour. Window ventilation and direct radiation is permitted if foul air ducts have a cross section area of 10 sq. in. per pupil.
25. Wisconsin--30 cu. ft. of air circulation per pupil per minute or 6 air changes per hour, the larger to govern this factor. At least 10 cu. ft. of outside air per pupil per minute. In corridors at least 10 cu. ft. per linear foot per minute.

The above tabulation shows that a relatively large number of states have established minimum requirements for the ventilation of school buildings. Some of the requirements seem to apply to classrooms only. Others, as previously stated, are quite general in nature. Still others specify different standards for various rooms or portions of the building. In some instances, detailed construction specifications are to be found, regulating height and location of fresh air inlets, height of foul air outlets, placing of radiators, type of hot air heaters, materials and construction of ducts and other details.

It may be noted that most requirements are specific in requiring the introduction of fresh outside air. However, the amount varies from ten cubic feet per pupil per hour to thirty cubic feet. It is questionable whether this larger requirement can be complied with, and as pointed out previously, there is a question as to its necessity or desirability. The standard of thirty cubic feet per pupil per hour appears to have been commonly accepted at one time. More recently it has been either questioned or rejected by large numbers of architects and heating engineers.

It would probably be wise for states to repeal specific requirements concerning ventilation, as has been done by the National Council on Schoolhouse Construction, until such time as further research enables the establishment of reasonable and well founded standards.

The fact that so many states have established minimum requirements concerning adequate ventilation demonstrates the concern on the part of those charged with this responsibility for pupil health and welfare in this respect.

Electric Service

The National Council makes four recommendations concerning electric service, the first of a general nature and the last three concerned with more detailed specifications.

10. That all electric wiring, etc. be done in accordance with the National Electric Code except that open wiring such as knob and tube wiring is not recommended.

The following states require that all wiring be done in accordance with this code.

- | | |
|----------------|------------------|
| 1. Alabama | 7. Kentucky |
| 2. Colorado | 8. Maryland |
| 3. Connecticut | 9. Massachusetts |
| 4. Delaware | 10. Ohio |
| 5. Florida | 11. Virginia |
| 6. Illinois | |

Virginia requires that all wiring conform also to the code of the South-Eastern Underwriters' Association.

Wisconsin requires that all installations meet the requirements of the Wisconsin State Electric Code.

There can be no doubt, however, that code requirements, both state and local, must be complied with in the states where no such requirements are included in the school building code. Certain aspects of all construction are regulated by general codes in all states. Specifications for all types and kinds of construction are usually included. Such codes are commonly found where departure from approved practice would be hazardous to the community. Codes governing electric wiring fall in this category. It is, however, questionable whether such state or local codes establish standards in all instances equivalent to that established by the National Electric Code.

11. That adequate outlets for all types of needed appliances and equipment be provided in all rooms.

1. Connecticut--same. Pilot light protection also required at switches.
2. Pennsylvania--same.
3. Virginia--same.

12. That the capacity of all service connections, feeders, main and branch panels, and all circuits be such that future extensions and extended uses may be made.

Only Idaho and Pennsylvania have requirements similar to this recommendation.

13. That stage feeders in particular be of such capacity that extensions for dramatic and other activities be provided for.

No state has a requirement containing such a specification.

While eleven states have requirements specifying that wiring be done according to code, only four states have requirements that go beyond this or relate to detail.

Public Address System

The National Council has formulated a list of four recommendations relating to the installation of public address systems and radio receivers. These four recommendations are listed below in sequence.

14. That provisions be made for the installation of a public address system.

15. That this include a microphone and loud speaker equipment for large assembly spaces.

16. That each instructional room be equipped with a speaker.

17. That the distributing system include an outside radio receiver.

Two states only have such requirements. Connecticut has requirements in effect corresponding to all four of these recommendations and applying to all buildings with enrollments of three hundred or more. Virginia requires that provisions be made for future installation of a loud speaker system by means of adequate conduits in all buildings of six or more classrooms.

Inasmuch as most codes are not of recent date, one should scarcely expect to find public address systems, or even provision for their future installation, a common subject for requirements.

Service Rooms

The National Council has adopted recommendations relating to two kinds of service rooms, boiler or heater rooms and service rooms for janitors and engineers. Four recommendations deal with the planning and construction of the boiler or heating room and fuel room.

Boiler or Heating Rooms

18. That spaces devoted to the housing of heating and ventilating equipment be ample in size and accessible to permit effective arrangement and servicing of all devices.

Kentucky is the only state with a specific requirement to this effect.

19. That boiler or heating rooms be of fireproof construction, preferably without being used as an engineer's work-

room.

States with regulations of this kind are as follows:

1. Alabama--fire-resistive construction with approved fire doors.
2. California--3-hour fire resistance rating if solid or liquid fuel is burned; if gas fuel a 1-hour rating.
3. Connecticut--fire-resisting, 2-hour fire rating for 2 or more story buildings and 1-hour for 1 story buildings; self-closing kalamein doors.
4. Delaware--same, self-closing fire doors.
5. Florida--fire-resisting, self-closing fire doors.
6. Idaho--same for 2 story buildings, fire-resisting for 1 story buildings.
7. Illinois--same, self-closing fire doors.
8. Kentucky--same.
9. Maryland--fire-resisting with not less than 3-hour fire rating, self-closing fire doors.
10. Massachusetts--same, self-closing fire doors.
11. Michigan--fire-resisting, self-closing fire doors.
12. New Jersey--same, Underwriters' approved type fire doors.
13. New York--fire walls and fire-resistant ceiling.
14. Ohio--same, self-closing fire doors.
15. Pennsylvania--fire-resisting, self-closing doors.
16. South Carolina--ceiling of metal lath and plaster or two thicknesses of asbestos paper and one thickness of sheet metal.
17. Virginia--fire-resisting.
18. Wisconsin--fire-resisting, not less than 4-hour fire rating for 2 or more story buildings.

Eighteen states have requirements for fireproof or fire-resistant construction of all boiler or heater rooms. Attention should be called to the fact that these terms seem to be used interchangeably. It may also be noted that three states specify the fire rating in terms of hours as is done in the Building Code of the National Board of Fire Underwriters. This recommendation of the National Council is at variance with number five in Chapter III, entitled "General Construction," which recommends that heater rooms have not less than a semi-fireproof rating as defined by the Underwriters' Code.

20. That boiler or heating rooms be adequately lighted by windows and be provided with two means of exit, one of which

leads directly to the outside.

The five states listed below have similar requirements.

- | | |
|-------------|------------------|
| 1. Florida | 4. Massachusetts |
| 2. Kentucky | 5. Pennsylvania |
| 3. Maryland | |

Pennsylvania, however, does not specify that one exit lead directly to the outside. California does not require two exits but specifies that one exit shall lead directly to the outside.

21. That fuel storage rooms be fireproof and immediately accessible to firing space.

1. Connecticut--fire-resisting, 2-hour fire rating for buildings of 2 or more stories, and 1-hour for 1 story buildings.
2. Delaware--same.
3. Florida--fire-resisting.
4. Illinois--same.
5. Kentucky--same.
6. Maryland--fire-resisting, 3-hour fire rating.
7. Massachusetts--same.
8. New York--fire-resisting.
9. Ohio--same.
10. Virginia--fire-resisting.
11. Wisconsin--fire-resisting, not less than 4-hour fire rating for 2 or more story buildings.

All but seven of the states requiring either fire-resisting or fireproof construction for boiler or heater rooms have requirements specifying the same construction for fuel rooms. These seven states are Alabama, California, Idaho, Michigan, New Jersey, Pennsylvania, and South Carolina. While it may be the intent in these cases to include the fuel room as part of the boiler or heater room, it is nevertheless omitted from mention in each instance.

Service Rooms for Janitors and Engineers

Two recommendations are found relating to service rooms for janitors and engineers.

22. That suitable service rooms or spaces for engineers or janitors be provided in all buildings.

No state except Connecticut has a specific requirement

of this kind in effect. Connecticut specifies not only work spaces but supply room and receiving room.

23. That separate water closets and wash sinks be provided in connection with such rooms for janitors and workmen. That, where women are employed, similar facilities be also provided.

Connecticut, Idaho, and Virginia have requirements of this nature.

Summary

It was noted that only eight states have requirements designed to insure adequate and safe water supply. It is, however, probable that such regulations are established by either state or local boards of health. No states have requirements specifying the minimum amount in per pupil terms as does the recommendation of the National Council. General terms only, such as adequate and sufficient, are employed in those states where requirements exist, and no attempt is made to define these terms. Since the amount of water available is usually unlimited it is questionable whether a specific requirement in terms of cubic feet per pupil is necessary. It is also unlikely that any responsible body charged with the operation and administration of schools would assume the responsibility of operating a school plant with a water supply that was limited or that demanded restriction or curtailment in use. Requirements specifying that a supply of hot water be provided are found in only four states. Inasmuch as hot water is highly desirable for sanitary reasons and provision for a hot water supply can be readily made, it would seem that such a requirement is entirely reasonable and should be included in every state code. Other recommendations of the National Council relating to water supply, while highly desirable as specification for installation, are very infrequently incorporated into state requirements.

Eighteen states have requirements concerning heating. The general practice is to specify a minimum indoor temperature that must be maintained in relation to the minimum outdoor temperature which prevails within the boundaries of the state. Requirements are usually much briefer and less specific than the recommendation of the National Council. Usually they are quite inadequate in light of present day knowledge of heating factors

involved. Air motion is unrecognized in any requirement. Humidity is mentioned in only three instances, and only three states make special recognition of heating special areas such as shops, gymnasiums, corridors, and such other areas as should be accorded special treatment. Furthermore, only five states specify or recommend automatic temperature control. This latter should by all means be a universal requirement inasmuch as effective temperature control and uniformity in heating is impossible without such automatic control. The importance of proper temperature to both health and efficiency is well established. In light of the facts enumerated above, coupled with the fact that only two states require special provision for heating special units at other than school hours, it is evident that state requirements in almost all instances are inadequate and permit standards below that established by the recommendations of the National Council.

Twenty-five states have requirements concerning ventilation. Of this total more than one-half specify the introduction of a specific number of cubic feet of fresh heated air per pupil per minute by means of mechanical ventilation. There is a variation in requirements ranging from ten to thirty cubic feet, however. Such requirements are more specific than the recommendation of the National Council. Whether the more rigid requirements are either attainable or justifiable is open to serious doubt. On the other hand the recommendation of the National Council is so general and undefined as to be meaningless and of no value in the planning of construction. The reason for such lack of specificity is sound however. Research to date does not permit establishment of any scientifically correct requirement. There is clearly a need for further research in this area. Hans W. Schmidt, Supervisor of Buildings in the Department of Public Instruction, Wisconsin, in two articles published in 1940 discussed the problems associated with proper ventilation of school buildings and deplored the lack of adequate research in this field.¹

Seagers, in the latest issue of the Review of Educational

¹Hans W. Schmidt, "Art of Heating and Ventilating," Nations Schools, XXV (June, 1940), 33-35; Schmidt, "Let's Learn More About Ventilation," ibid., XXVI (October, 1940), 62-64.

Research devoted to School Plant and Equipment, reports that there has been very little recent research on over-all ventilation of school buildings, but that intensive studies have been made on some phases of ventilation.¹ He maintains that the quantity theory, diluting the air in the room with thirty cubic feet of fresh air per minute, which was based upon experiments by Pettenkofer in 1863 has now been generally discarded in favor of the comfort and health theory. This latter theory advances atmospheric quality and thermal balance of air as the most significant factors in proper ventilation.

Nelbach, recently active in the comprehensive survey of schoolhouse heating and ventilation for the New York State Department of Education, asserts that it is essential to attack the problem of proper and adequate ventilation by beginning with an analysis of the underlying physiological principles. He maintains that volume of fresh air itself is not of significance and therefore there is no need to recommend a specific volume for rooms.² He states, however, that "there are gaps in our knowledge, probably some of which will remain for later years to reveal. Continued research must certainly be stimulated."³

It is clear that our knowledge of proper and adequate ventilation does not justify, to date, the establishment of rigid regulations. Not until research has provided the equipment to obtain such conditions, is it possible to formulate adequate and valid minimum requirements.

Eleven states have requirements specifying that wiring be done in accordance with the National Electric Code. One state requires that the State Electric Code only be followed. There is little doubt that in all instances wiring specifications must be done according to some code, either state or local, inasmuch as general codes govern construction of all kinds. However, a requirement specifying that wiring be done in accordance with both the local and state code and the National Electric Code

¹Paul W. Seagers, "Heating and Ventilating the School Building," Review of Educational Research, XV, No. 1 (1945), 51.

²Philip E. Nelbach, "Modern Performance Standards for School Heating and Ventilation," American School Board Journal, CXII (January, 1946), 37-39.

³Ibid., p. 39.

would seem to be highly desirable in that it would insure a safe minimum standard for this aspect of construction in event that the general state or local code does not establish standards adequate for schoolhouse construction. Few states have requirements concerning further details of electric work which are covered in three additional recommendations of the National Council. One of these recommendations, namely that specifying sufficient outlets for all needed equipment, while not specific in establishing a minimum, is very desirable.

In general the requirements that exist meet the standards set up by the National Council. The real lack is the omission of requirements specifying that provisions be made for a public address system. It has been noted before that few requirements exist concerning factors other than those relating to safety and health.

A relatively large number of states have requirements establishing minimum standards for two types of service rooms, namely boiler and fuel storage rooms. Again there is some confusion in the use of the terms "fireproofing" and "fire-resistant." However, it seems clear that most states require only fire-resistant construction whereas the National Council recommends that construction be fireproof.

Requirements concerning drinking fountains, service sinks and showers are negligible and so incomplete as to be of little value.

A real need for improved standards as a result of revised requirements for all sanitary facilities is apparent. However, sound and justifiable requirements, in most instances, must wait upon further study and research, with the end in view of adequately serving pupil needs and at a reasonable and justifiable cost.

CHAPTER VII

ILLUMINATION

Illumination is of two kinds, natural and artificial. Natural illumination is determined by fenestration. Consequently, requirements and standards have been developed for both fenestration and artificial illumination, although in school buildings artificial illumination is used almost exclusively to supplement natural illumination.

Fenestration

Thirteen recommendations relating to fenestration have been formulated and adopted by the National Council on Schoolhouse Construction concerning the five following aspects of fenestration.

1. Location of windows in instruction rooms
2. Glass area of windows
3. Natural illumination of stairs and corridors
4. Shades and blinds
5. Relation to seating

Table 12 shows those states having requirements corresponding to the recommendations of the National Council.

This table shows that three aspects of construction are quite frequently the subject of requirements. Twenty-three states have requirements specifying the ratio of glass area to floor area. Twenty states require that light be admitted either from the left or left and rear. Nineteen states specify the maximum distance separating the top of the upper sash and the ceiling. Other requirements are less frequently established. However, it is clear that requirements which make the more essential provisions for adequate and proper fenestration are rather general. Requirements specifying the installation and type of shades or blinds are extremely rare. However, it is apparent that more attention or consideration has been devoted to fenestration than has been devoted to a number of other aspects or

TABLE 12

STATES HAVING REQUIREMENTS CONCERNING FENESTRATION
CORRESPONDING TO THE RECOMMENDATIONS
OF THE NATIONAL COUNCIL

States	Recommendations of the National Council by Number*														Total
	Location					Area		Stairs and Corridors	Shades and Blinds				Relating to Seating		
	1	2	3	4	5	6	7	8	9	10	11	12	13		
Alabama.....	x	.	.	x	x	.	x	x	.	.	.	.	x	6	
California....	.	.	.	.	.	.	.	x	.	.	.	.	.	1	
Connecticut...	x	.	x	x	x	x	x	x	x	x	.	x	x	11	
Delaware.....	x	x	.	x	.	.	x	x	.	.	.	x	x	7	
Florida.....	.	x	x	.	.	.	x	x	.	.	.	.	x	5	
Idaho.....	x	.	.	x	x	.	x	.	.	.	.	.	.	4	
Indiana.....	x	.	.	x	x	.	x	.	.	.	.	.	x	5	
Kentucky.....	x	.	x	.	x	.	x	x	x	.	.	x	x	8	
Maine.....	x	.	x	x	.	.	x	.	.	.	.	.	x	5	
Maryland.....	x	x	x	x	x	.	x	x	.	.	.	.	x	8	
Massachusetts.	.	.	.	x	.	.	x	.	.	.	.	.	.	2	
Michigan.....	x	.	x	.	.	.	x	.	x	.	.	.	x	5	
Montana.....	.	.	.	x	.	.	x	.	.	.	.	.	x	3	
New Jersey....	.	.	.	x	.	.	x	.	.	.	.	.	x	3	
New York.....	x	.	.	x	.	.	x	.	.	.	.	.	x	4	
North Dakota..	.	.	.	.	.	.	x	.	.	.	.	.	x	2	
Ohio.....	.	.	.	x	.	.	x	.	.	.	.	.	x	3	
Oklahoma.....	x	.	.	x	x	.	.	.	.	.	.	.	x	4	
Pennsylvania..	.	x	.	x	x	.	x	x	x	.	.	.	x	7	
South Carolina	x	x	.	.	.	.	x	x	.	.	.	.	.	4	
Texas.....	x	.	.	x	x	.	x	.	.	.	.	.	x	5	
Vermont.....	.	.	.	x	.	.	x	x	x	.	.	.	x	5	
Virginia.....	.	.	x	x	x	.	x	x	.	.	.	.	x	6	
West Virginia.	x	x	x	x	x	.	x	.	.	.	.	.	.	6	
Wisconsin.....	.	.	.	x	x	x	x	x	x	.	.	.	x	7	
Total.....	14	6	8	19	12	2	23	12	6	1	0	3	20	...	

*1. Unilateral lighting (p. 106); 2. Windows on long axis of room (p. 106); 3. East and west fenestration preferred (p. 107); 4. Proximity to ceiling (p. 107); 5. Height of sill or stool (p. 108); 6. Adequate illumination for all desks (p. 108); 7. Ratio of glass area to floor area (p. 108); 8. Illumination of stairs and corridors (p. 110); 9. Specifications for fabric shades (p. 111); 10. Venetian blinds (p. 111); 11. Specifications for draw curtains (p. 111); 12. Specifications for opaque shades (p. 111); 13. Relation to seating (p. 111).

elements of construction.

Table 12 shows also that a number of states have relatively complete codes. If shades and blinds were omitted from this tabulation it is clear that state regulation would, in most states establish standards equal to that recommended by the National Council.

Location of Windows in Instruction Rooms

Five of these recommendations relate to the location of windows in classrooms and other rooms used for instructional purposes.

1. That all classrooms have unilateral lighting.

The following fourteen states have requirements of this kind.

- | | |
|----------------|--------------------|
| 1. Alabama | 8. Maryland |
| 2. Connecticut | 9. Michigan |
| 3. Delaware | 10. New York |
| 4. Idaho | 11. Oklahoma |
| 5. Indiana | 12. South Carolina |
| 6. Kentucky | 13. Texas |
| 7. Maine | 14. West Virginia |

Florida recommends unilateral lighting but in some instances permits supplementary windows in the rear. All states which do not require unilateral lighting do prescribe, however, that the light be admitted from the left and the rear of the room. Nine states permit lighting of this kind. It is evident that unilateral lighting of instructional rooms is not regarded as essential and possibly not more desirable than bilateral lighting.

2. That windows be placed on the long axis of the room.

Only six states have specific requirements containing a provision of this kind.

- | | |
|-------------|-------------------|
| 1. Delaware | 4. Pennsylvania |
| 2. Florida | 5. South Carolina |
| 3. Maryland | 6. Virginia |

It is extremely doubtful if this provision is essential. Requirements relating to the length and width of classrooms together with requirements relating to the admission of light from the left or left and rear make such construction mandatory, and

preclude the possibility of placing windows on the short side of the room.

3. That east and west fenestration is to be preferred to north and south.

Seven states recommend east and west fenestration as preferable.

- | | |
|----------------|------------------|
| 1. Connecticut | 5. Maryland |
| 2. Florida | 6. Virginia |
| 3. Kentucky | 7. West Virginia |
| 4. Maine | |

Michigan, however, recommends north as preferable to east and west fenestration.

4. That the top of the upper sash of windows be six inches or less below the ceiling.

The following states have requirements covering this aspect of construction.

1. Alabama--not more than 12 inches.
2. Connecticut--as near the ceiling as possible.
3. Delaware--same.
4. Idaho--same.
5. Indiana--not more than 12 inches.
6. Maine--not more than 12 inches.
7. Maryland--same.
8. Massachusetts--not more than 8 inches.
9. Montana--not more than 12 inches.
10. New Jersey--as near the ceiling as possible.
11. New York--as near the ceiling as possible.
12. Ohio--not more than 8 inches.
13. Oklahoma--same.
14. Pennsylvania--as near the ceiling as possible.
15. Texas--same.
16. Vermont--as near the ceiling as possible.
17. Virginia--same.
18. West Virginia--same.
19. Wisconsin--not more than 12 inches.

It is clear that most states with requirements concerning fenestration recognize the importance of securing sufficient light on the desks opposite the window side of the rooms used for instruction. However, the recommended maximum of six inches

from top of upper sash to ceiling is not universally required.

5. That no windowpanes be placed so low that light enters the room below the plane of vision of pupils seated next to the window.

States having requirements concerning this factor without exception specify the height of the sill or stool above the floor. Thus the requirements are more specific than the recommendation of the National Council.

1. Alabama--at least 38 inches above the floor.
2. Connecticut--at least 36 inches above the floor.
3. Idaho--at least 42 inches above the floor.
4. Indiana--at least 48 inches above the floor.
5. Kentucky--at least 36 inches above the floor.
6. Maryland--36 to 42 inches above the floor.
7. Oklahoma--at least 36 inches above the floor.
8. Pennsylvania--at least 40 inches above the floor.
9. Texas--at least 42 inches above the floor.
10. Virginia--at least 38 inches above the floor.
11. West Virginia--at least 42 inches above the floor.
12. Wisconsin--at least 36 inches above the floor.

In general the variation ranges from thirty-six to forty-two inches, which is small enough to provide for a considerable degree of uniformity among states. Indiana, with a requirement of forty-eight inches, provides the only significant variation.

Glass Area of Windows

6. That natural daylight illumination be adequate at the desks of all pupils.

This recommendation of the National Council seems both superfluous and too general to be of much value. All the requirements relating to the location and glass areas of windows are designed to provide adequate illumination at the desks of all pupils. Furthermore, these requirements in most instances are sufficiently specific to insure adequate illumination. In light of this situation; it would be unusual to find requirements corresponding to this recommendation. Connecticut and Wisconsin are the only states with a similar requirement of so general nature as is the recommendation.

7. That the ratio of window area to floor area be governed

by the intensity of illumination necessary for a proper distribution of a sufficient amount of light. For different regions of the country, the actual ratio of required glass area to floor area in instruction rooms, libraries and study halls will vary between one-fourth and one-sixth.

Twenty-three states prescribe a ratio of glass area to floor area. Some requirements are expressed in terms of percentage and some in fractional terms. In order to acquire uniformity for the purpose of comparison the terms in each case have been translated into percentages. It should be borne in mind that the range of variation recommended by the National Council extends from sixteen and sixty-six one-hundredths per cent to twenty-five per cent.

1. Alabama--14.29 per cent.
2. Connecticut--20 per cent.
3. Delaware--20 per cent.
4. Florida--below 27° latitude, 15 per cent; above 27° latitude, 18 per cent.
5. Idaho--16.66 per cent.
6. Indiana--16.66 per cent.
7. Kentucky--16.66 per cent.
8. Maine--20 per cent.
9. Maryland--not less than 18.18 per cent nor more than 20 per cent.
10. Massachusetts--20 per cent.
11. Michigan--25 per cent.
12. Montana--14.29 per cent.
13. New Jersey--20 per cent.
14. New York--16.66 per cent.
15. North Dakota--20 per cent.
16. Ohio--20 per cent.
17. Pennsylvania--16.66 per cent if unilateral lighting, and 20 per cent if bilateral.
18. South Carolina--20 per cent.
19. Texas--16.66 per cent.
20. Vermont--20 per cent.
21. Virginia--20 per cent.
22. West Virginia--16.66 per cent.
23. Wisconsin--16.66 per cent and 12.50 per cent if room has adequate sky lights.

This tabulation reveals variation ranging from fourteen

and twenty-nine hundredths per cent to twenty-five per cent. It would naturally be expected that a larger percentage of glass area would be required in the more northerly states and a smaller percentage in the more southerly states. However, the tabulation does not show this expectation to be true. Texas and Wisconsin both specify the same ratio. The same is true of South Carolina and Maine. It is apparent that there is no generally accepted standard based on approximate latitudes. The question might be properly raised as to whether too great a glass area in certain latitudes does not produce a glare that is injurious to the eyes of the pupils in attendance. It should be noted that only one state, Michigan, requires as much as twenty-five per cent, which is the higher limit of the recommendation of the National Council. It would seem that other states of similar latitude have ratios that are inadequate for proper lighting.

Natural Illumination of Stairs and Corridors

8. That stairways and corridors be well lighted by windows, glass block panels and openings.

Twelve states have requirements of this nature although none mention glass blocks or specify means other than windows for lighting stairways or corridors. Following are the states with requirements similar to the recommendation.

- | | |
|----------------|-------------------|
| 1. Alabama | 7. Maryland |
| 2. California | 8. Pennsylvania |
| 3. Connecticut | 9. South Carolina |
| 4. Delaware | 10. Vermont |
| 5. Florida | 11. Virginia |
| 6. Kentucky | 12. Wisconsin |

The requirement in effect in Virginia stipulates only corridors. It further specifies that the lighting from windows shall provide an intensity of three foot candles on clear days. California requires only an adequate system of lighting, either natural or artificial.

Since adequate natural lighting of both stairs and corridors is highly desirable, it would seem wise that more states should adopt specific requirements of this kind.

Shades and Blinds

The National Council has adopted four recommendations

relating to the materials and installation of blinds and shades. State requirements of this kind are infrequent.

9. That fabric shades be of the multiple roller type permitting independent shading of the upper and lower portions of the windows, and that they be of highly translucent material of a color harmonizing with the wall colors.

Six states have similar requirements; not all of the requirements, however, specifying color.

- | | |
|----------------|-----------------|
| 1. Connecticut | 4. Pennsylvania |
| 2. Kentucky | 5. Virginia |
| 3. Michigan | 6. Wisconsin |

10. That venetian blinds be of light colors to increase light reflection.

Connecticut is the only state making mention of venetian blinds. Their use is recommended in this state but no recommendation or specification is made as to the color.

11. That where draw curtains are used in classrooms they be of light colored highly translucent materials and so installed that they may be completely withdrawn from the glass areas.

No requirements relating to draw curtains are in effect in any state.

12. That opaque darkening curtains be provided in addition to translucent shades in science laboratories, social science laboratories and other rooms where the use of picture projectors is dictated by the educational program.

Only three states have requirements of this kind, namely: Connecticut, Delaware, and Kentucky.

Relation to Seating

13. That tables and desks be arranged so that pupils will not be obliged to face the windows.

Twenty states have requirements of this nature. However, in every case the requirements are even more specific, stipulating that the light shall be admitted from either the left, or the left and rear.

1. Alabama--left or left and rear.
2. Connecticut--left.
3. Delaware--left.
4. Florida--left or left and rear.
5. Indiana--left.

6. Kentucky--left.
7. Maine--left.
8. Maryland--left.
9. Michigan--left or left and rear.
10. Montana--left or left and rear.
11. New Jersey--left or left and rear.
12. New York--left.
13. North Dakota--left or left and rear.
14. Ohio--left or left and rear.
15. Oklahoma--left.
16. Pennsylvania--left or left and rear.
17. Texas--left.
18. Vermont--left or left and rear.
19. Virginia--left or left and rear.
20. Wisconsin--left or left and rear.

Artificial Illumination

The National Council has formulated seven recommendations concerning intensities, control, and quality and diffusion of artificial illumination. A relatively small number of states have requirements of this kind in effect. About half of the states with requirements relating to fenestration have regulations concerning artificial illumination. This may be explained by the fact that electricity is not available in all locations. However, it would seem wise to have requirements in all instances where artificial lighting is by means of electricity, inasmuch as adequate lighting of classrooms is dependent upon supplemental artificial illumination as well as upon fenestration on cloudy days.

Table 13 shows those states which have minimum requirements corresponding to the seven recommendations of the National Council relating to artificial lighting.

It is an interesting fact that while twenty-five states have minimum requirements concerning one or more aspects of natural lighting or fenestration only fourteen have requirements concerning artificial illumination. The largest number of requirements are those establishing minimum standards for intensities in terms of foot-candles. Thirteen states have requirements of this kind.

Few states have codes for illumination comparable to the

recommendations of the National Council. Connecticut, with fifteen requirements corresponding to fifteen of the National Council's twenty recommendations, has the most complete code. The Wisconsin code on artificial lighting adopted February 7, 1944, is one of the most complete of its kind. It may be said, however, that in all states where requirements are in effect they are concerned with making provision for the more obvious and essential aspects involved in securing adequate lighting. Few requirements are concerned with the less obvious aspects or details of installation and equipment.

TABLE 13

STATES HAVING REQUIREMENTS CONCERNING ARTIFICIAL ILLUMINATION
CORRESPONDING TO THE RECOMMENDATIONS OF THE NATIONAL COUNCIL

States	Recommendations of the National Council by Number*							Total	
	Intensi- ties	Con- trol	Quality and Diffusion						
			1	2	3	4	5		6
Arkansas.....	.	.	.	.	.	.	.	X	1
Colorado.....	X	.	.	.	.	.	.	.	1
Connecticut..	X	X	X	X	.	.	.	X	5
Delaware.....	X	.	X	.	.	.	.	X	3
Florida.....	X	.	.	.	.	.	.	.	1
Kentucky.....	X	.	.	.	.	.	.	X	2
Maine.....	X	X	X	.	.	.	.	.	3
Maryland.....*	X	X	.	.	.	.	.	X	3
Massachusetts	X	.	X	.	.	.	.	.	2
Michigan.....	X	X	.	.	.	.	.	X	3
Pennsylvania.	X	X	X	.	.	.	.	X	4
Virginia.....	X	.	.	.	.	.	.	.	1
West Virginia	X	.	.	.	.	.	.	.	1
Wisconsin....	X	X	X	X	.	.	.	X	5
Total.....	13	6	6	2	0	0	0	8	...

*1. Intensities (p. 113); 2. Control (p. 116); 3. Use of exposed lamps (p. 116); 4. Surface brightness of luminaries (p. 117); 5. Fluorescent lamps (p. 117); 6. Intensity in indirect lighting (p. 117); 7. Ceiling and wall finish (p. 117).

Intensities

1. That the minimum effective illumination at working levels be as follows:

a. In locker rooms, corridors, stairs, toilets, and similar spaces 5 f.c.

- b. In classrooms, lecture rooms, offices, gymnasiums and auditoriums 10 f.c.
- c. In study halls, libraries, shops and laboratories, excepting those in sub-division (d) below 15 f.c.
- c. In sewing rooms, drafting rooms, print shops, jewelry shops or other specialized rooms housing activities involving exceptionally difficult seeing tasks 20 f.c.

State requirements do not always include all of the kinds of rooms included in the recommendations of the National Council. Furthermore, the room classifications for light intensities in the state requirements do not always correspond to the classification employed in the recommendations of the National Council. However, insofar as possible, the classification set up in the recommendation of the National Council is followed where there is substantial agreement. Exceptions are noted.

a. Locker rooms, corridors, stairs, toilets, and similar spaces 5 f.c.

- (1) Colorado--Standards of the Society of Illuminating Engineers.
- (2) Connecticut--3 f.c. required.
- (3) Florida--Corridors, 3 f.c.; stairways, 4 f.c.
- (4) Kentucky--Corridors 3 f.c.; stairways well lighted by artificial light.
- (5) Maine--Same, excepting toilets 8 f.c.
- (6) Maryland--4 f.c.
- (7) Massachusetts--1 f.c.
- (8) Michigan--toilets 3 f.c.
- (9) Pennsylvania--2 f.c.; shower and locker rooms 4 f.c.
- (10) Virginia--Corridors and stairs 3 f.c.
- (11) Wisconsin--3 f.c.

Minimum requirements in the states are in general about two foot-candles less than the recommended standard.

b. Classrooms, lecture rooms, offices, gymnasiums, and auditoriums, 10 f.c.

- (1) Colorado--Standards of the Society of Illuminating Engineers.
- (2) Connecticut--Same, excepting gymnasiums 8 f.c. and auditoriums 5 f.c.
- (3) Delaware--5 f.c. excepting auditoriums 3 f.c.
- (4) Florida--Same.

- (5) Maine--Same.
- (6) Maryland--8 f.c. if used in daytime only and 15 f.c. if used at night, auditorium requirement 6 f.c.
- (7) Massachusetts--Classrooms 5 f.c., gymnasiums and auditoriums 3 f.c.
- (8) Michigan--Classrooms 10 f.c.
- (9) Pennsylvania--8 f.c. excepting auditoriums 5 f.c.
- (10) West Virginia--Classrooms 8 f.c.
- (11) Wisconsin--12 f.c. excepting auditoriums 8 f.c.

Again it is found that minimum requirements in the several states are somewhat less than the recommendation standard. Wisconsin, however, requires two foot-candles more except in auditorium lighting.

c. Study halls, libraries, shops, laboratories excepting those listed in (d) 15 f.c.

- (1) Colorado--Standards of the Society of Illuminating Engineers.
- (2) Connecticut--10 f.c.
- (3) Delaware--5 f.c.
- (4) Florida--10 f.c.
- (5) Maine--10 f.c.
- (6) Maryland--8 f.c. if used in daytime only and 15 f.c. if used at night.
- (7) Massachusetts--5 f.c. excepting manual training 8 f.c.
- (8) Michigan--10 f.c.
- (9) Pennsylvania--8 f.c.
- (10) West Virginia--8 f.c.
- (11) Wisconsin--12 f.c.

In general, state minimum requirements are three to seven foot-candles less than the recommendation of the National Council for this class of instructional rooms.

d. Sewing rooms, drafting rooms, print shops, jewelry shops, and similar specialized rooms 20 f.c.

- (1) Colorado--Standards of the Society of Illuminating Engineers.
- (2) Connecticut--15 f.c.
- (3) Maryland--8 f.c. if used in daytime only and 25 f.c. if used at night.

- (4) Massachusetts--8 f.c. excepting print shops
12 f.c.
- (5) Pennsylvania--15 f.c.
- (6) Wisconsin--18 f.c.

Only the six states listed have requirements establishing minimum lighting for these types of specialized rooms. In all other states it seems logical to assume that the minimum requirements would be those established for classrooms and other instructional rooms. The requirements established in the six states listed are somewhat below those recommended by the National Council. It seems apparent that requirements in effect establish standards that are in a number of instances less than adequate.

Control

2. That lighting circuits be arranged to serve rows of light parallel to windows, with switch control for each row.

Only six states have requirements specifying this type of installation or control.

- | | |
|----------------|-----------------|
| 1. Connecticut | 4. Michigan |
| 2. Maine | 5. Pennsylvania |
| 3. Maryland | 6. Wisconsin |

Since such specifications are in the interest of economy, without sacrificing adequate lighting, it would be most desirable to have similar requirements in effect in all states.

Quality and Diffusion

A list of five recommendations relating to the quality and diffusion of light are made by the National Council. However, few states have requirements corresponding to one or more of these requirements.

3. That the use of exposed incandescent lamps for general room lighting, whether frosted or clear be avoided. Such lamps may be permissible for local illumination on the work, when used in suitable opaque or semi-opaque reflectors which shield the lamp from the ordinary line of vision, and provided they are so placed as to avoid glaring reflections from the working surfaces.

While no state has a requirement as specific in detail as these recommendations, the following six states have require-

ments requiring either indirect or diffuse lighting fixtures, and prohibiting the use of exposed lamps.

- | | |
|----------------|------------------|
| 1. Connecticut | 4. Massachusetts |
| 2. Delaware | 5. Pennsylvania |
| 3. Maine | 6. Wisconsin |

4. That the surface of luminaries be such that the brightness transmitted does not exceed two and five-tenths candle-power per square inch at any point in the normally visible zone.

Connecticut and Wisconsin have similar requirements with a maximum of three candlepower per square inch. Connecticut recommends a maximum of two and five-tenths. No other states have requirements of this kind.

5. That fluorescent lamps (which have maximum brightness of five to six candlepower per square inch) may be used for direct general lighting in shops, provided they be shielded from the ordinary line of vision.

No state has any requirement either permitting or prohibiting the use of fluorescent lighting.

6. That where indirect lighting alone is used, the maximum intensity of illumination on the working plane be kept below fifty foot-candles.

Again it is found that no state has a requirement corresponding to this recommendation.

7. That reflected glare from all light sources be minimized by using non-glossy paint finishes on walls, ceilings, trim, and furnishings of schoolrooms. Ceiling finish may be nearly white, with matte surface and reflection coefficient of seventy-five to eighty per cent. Upper wall finish, also with matte surface, to have reflection coefficient of fifty to sixty per cent.

The following states have requirements of this nature.

1. Arkansas--non-glossy finish.
2. Connecticut--non-glossy finish; ceiling coefficient 60%, walls "sufficient" light reflecting coefficient.
3. Delaware--ceiling finish white or extremely light cream.
4. Kentucky--same, excepting coefficient for walls 52% to 78%.
5. Maine--same.

6. Michigan--non-glossy light color finish.
7. Pennsylvania--non-glossy finish.
8. Wisconsin--same, excepting coefficient for walls
45%--60%.

Summary

Most states among those with codes governing school plant construction have requirements relating to fenestration. Minimum requirements concerning three aspects of fenestration are most frequently found, namely, ratio of window area to floor area, proximity of the window to ceiling, and relation of table and desks to windows.

These requirements cover what are probably the most important factors as they relate to proper seeing and eye hygiene. They are designed to provide sufficient light in the rooms, insure adequate light on the side of the room opposite the windows, and eliminate the injurious effect on pupils directly facing light.

In all instances where these kinds of requirements exist, the standards are substantially equal to those recommended by the National Council, the only exceptions being found in certain of the more northerly states where the minimum window area is below the twenty-five per cent recommended. Other requirements corresponding to the remainder of the recommendations of the National Council are more infrequent. Certain of these remaining recommendations lack sufficient specificity to be of much value. At least one other, namely that recommending unilateral lighting, is open to some question in light of the development of modern methods of bilateral lighting.

Few states have requirements establishing specifications for shades or blinds. Inasmuch as translucent shades of the multiple roller type permitting independent shading of the upper and lower portions of the window are essential to proper daylighting of the classroom, this lack of requirements constitutes a serious omission.

It has been pointed out that few states have anything other than fragmentary codes establishing minimum standards for artificial illumination of school buildings. As a rule the requirements now in effect permit minimum intensities below those recommended by the National Council on Schoolhouse Construction.

The question may be properly raised as to what are adequate, safe, and justifiable intensities. Several things should be pointed out in this connection. In the first place, there is little scientific basis for any standards at present, and hence any statements of standards rest on arbitrary judgment. As might be expected most of the work in this area has been pioneered by the Illuminating Engineering Society. Recommended standards emanating from this organization have been greatly increased over the past fifteen years, in some instances being tripled. In 1941 the Consumers Union reported that half of the members of the Illuminating Engineering Society are power companies. Thus it is only natural that recommendations emanating from this source be viewed with scepticism. The National Society on School-house Construction declined to depart from the 1932 recommendations of the Illuminating Engineering Society to accept the 1938 revision of their standards which recommend considerably increased intensities, until such time as sufficient evidence supported the new standards.¹

Higgins points out that the amount of light needed to produce the most efficient work is still controversial.² Gibson concludes that "a fifteen foot-candle level is becoming established as the minimum desirable light intensity for classrooms."³ However, there are advocates for intensities ranging up to three-hundred foot-candles.

A new and very significant development has occurred in the field of lighting within the last few years. There has been a shift of emphasis from foot-candle intensities to the consideration of brightness, brightness contrast, and brightness ratios as the controlling factors in good seeing conditions. The unit of measurement is the footlambert and the instrument is called a brightness meter. Gibson has stated his conclusion as follows: "Brightness, brightness contrast, and brightness ratios finally have become generally recognized as the prime factors in

¹"Fluorescent Lighting," Consumers Union, VI (January, 1941), 15.

²Thomas J. Higgins, "Mechanical Equipment for the School," Architectural Record, XCV (March, 1944), 89-90.

³Charles D. Gibson, "School Plant Lighting," Review of Educational Research, XV, No. 1 (February, 1945), 45.

adequate illumination."¹ However, he points out that research is needed to develop and make available in quantities an instrument for measuring brightness, and that scientifically defensible brightness standards for visibility comfort need to be established. Darley suggests that "the brightness of the task should be of the order of two hundred and fifty foot-lamberts."² However, there is no evidence that is based on scientific investigations. He admits that "it is obvious that the brightness goal cannot be considered as a standard for the classroom today."³

While the shift in emphasis from intensity to quality of light is generally considered desirable, it is evident that as yet it is impossible to establish sound minimum requirements. It is possible that in light of the new developments in this field that it will become necessary to revise all present standards. While awaiting this development it is apparent that minimum requirements in effect in most states should be materially improved inasmuch as it is clear that they establish standards inadequate in light of present knowledge and best practice. However sound and justifiable standards still await further research.

No state has any requirement either permitting or prohibiting fluorescent lighting, while the National Council recommendations cautiously state that it may be used in shops. In view of our present limited knowledge it is doubtful if fluorescent lighting will be required in the near future although there is nothing to prohibit its use in any state.

It has been noted that few states have requirements either specifying non-glossy paint finishes or prescribing ceiling and wall finishes with minimum coefficients of reflection, both of which are essential conditions for adequate and proper lighting. The reasons for the importance of these two factors are obvious. The need for requirements of these kinds is accentuated by the recent shift in emphasis from intensities to quality of lighting or brightness. Darley states the case well.

¹Ibid., p. 48.

²William G. Darley, "Seeing in the Schoolhouse," American School Board Journal, CXI (August, 1945), 42.

³Ibid.

Research has emphasized that for best seeing conditions the brightness of surfaces in the visual field when looking at the work should not be higher than, nor much lower than the brightness of the work. Thus to create modern, comfortable seeing conditions, those who would presume to prescribe natural and artificial lighting facilities for the school-house must take into account the finishes of floors, furniture, chalkboard areas and trim, as well as take a more positive attitude toward the location of windows and desks and toward interior decoration generally.¹

¹Ibid., p. 29.

CHAPTER VIII

CLASSROOMS

A list of eighteen recommendations has been formulated by the National Council relating to the following eight aspects or details of classroom construction.

1. Conditions entering into the planning of classrooms.
2. Dimensions of classrooms.
3. Seating capacity of classrooms.
4. Aisles.
5. Doors to classrooms.
6. Chalk or crayon boards.
7. Color of walls and ceiling.
8. Coatrooms, wardrobes, and lockers.

Twenty-seven states have requirements corresponding to one or more of these recommendations.

Table 14 shows the states which have minimum requirements concerning classrooms corresponding to the recommendations of the National Council.

It is significant to note which factors in classroom planning and construction are most frequently required. Eighteen states have requirements specifying that some provision be made, either of coatroom, wardrobes, or lockers for storing outer clothing. Seventeen states have requirements in terms of square feet per pupil for the purpose of establishing seating capacity of classrooms. Fifteen states have requirements establishing minimums for both the width and the height of classrooms. Not more than ten states have requirements corresponding to any of the other fourteen factors which are the subject of National Council recommendations. It is apparent that almost all factors of classroom planning and construction are too infrequently the subject of minimum requirements.

An analysis of this table also shows that no state has requirements corresponding to all of the eighteen recommendations. Only the following seven states have requirements corresponding

to as many as half of the recommendations.

<u>States</u>	<u>Number of Requirements</u>
1. Connecticut	13
2. Pennsylvania	13
3. Wisconsin	13
4. Delaware	12
5. Kentucky	12
6. Maryland	9
7. Virginia	9

It is apparent that the codes in most of the states having requirements are incomplete and fragmentary. The need for a more universal acceptance of a sufficient number of minimum requirements for adequate classroom planning is evident.

The same procedure is followed in comparing state requirements with the recommendations of the National Council as has been used heretofore.

Special Provisions

There are two recommendations of this kind. Both are general in nature and are concerned with provisions for special features of construction and built-in equipment not always included in classroom specifications.

1. That in addition to mere classroom space, provision be made for heating and ventilation, blackboards, bulletin boards, supply cabinets, and bookcases.

Seven states have requirements of this nature, although not all of the items included in the recommendation are included in each state requirement. However, the following states have requirements substantially like this recommendation of the National Council.

1. Alabama	5. Maryland
2. Connecticut	6. Pennsylvania
3. Delaware	7. Virginia
4. Kentucky	

2. That other desirable features, depending upon the character of the school, include such items as provisions for room clock, temperature control, electric outlets for lighting, projection and vacuum cleaning, interphone connections, radio connections, lavatory and drinking facilities, project lockers,

TABLE 14

STATES HAVING REQUIREMENTS CONCERNING CLASSROOMS
CORRESPONDING TO THE RECOMMENDATIONS
OF THE NATIONAL COUNCIL

States	Recommendations of the National Council by Number*									
	Special Pro- visions		Dimensions					Seating Capacity	Aisles	
	1	2	3	4	5	6	7	8	9	10
Alabama.....	x	.	x	x	x	.	.	.	.	.
Arkansas.....	.	.	.	.	.	.	.	.	.	.
California.....	.	.	.	.	.	.	.	.	.	.
Connecticut...	x	x	x	x	x	.	.	x	.	.
Delaware.....	x	x	x	.	x	.	.	x	.	.
Florida.....	.	.	x	x	.	x	.	.	.	.
Idaho.....	.	.	.	x	.	.	.	x	.	.
Indiana.....	.	.	.	.	.	.	.	.	.	.
Kentucky.....	x	x	x	x	x	.	.	x	.	.
Maine.....	.	.	x	x	x	.	.	x	.	.
Maryland.....	x	.	x	x	x	.	.	x	.	.
Massachusetts.	.	.	x	.	.	.	.	.	x	x
Michigan.....	.	.	.	.	.	.	.	x	.	.
Montana.....	.	.	.	.	.	.	.	x	.	.
New Jersey....	.	.	.	x	.	.	.	x	.	.
New York.....	.	.	.	.	.	.	.	.	.	.
North Dakota..	.	.	.	x	.	.	.	x	.	.
Ohio.....	.	.	x	x	.	x	.	.	x	x
Oklahoma.....	.	.	.	.	.	.	.	x	.	.
Pennsylvania..	x	.	x	x	x	x	.	.	.	.
South Carolina	.	.	x	.	.	.	.	x	.	.
South Dakota..	.	.	.	.	.	.	.	x	.	.
Texas.....	.	.	x	.	.	.	.	.	.	.
Vermont.....	.	.	.	x	.	.	.	x	.	.
Virginia.....	x	.	x	x	x	.	.	x	.	.
West Virginia.	.	.	x	x	x	.	.	x	.	.
Wisconsin.....	.	.	x	x	x	.	.	x	x	x
Total.....	7	3	15	15	10	3	0	17	3	3

*1. Additional space for heating, bookcases, etc. (p. 125); 2. Special desirable features (p. 125); 3. Width (p. 126); 4. Height (p. 127); 5. Length (p. 127); 6. Distance between front wall and first row of seats (p. 128); 7. Distance between rear wall and last row of seats (p. 128); 8. Seating capacity (p. 128); 9. Width of aisles next to walls (p. 130); 10. Width of intermediate aisles (p. 130); 11. Specifications for classroom doors (p. 130); 12. Provision for sufficient chalk or crayon board (p. 131); 13. Width of chalk board (p. 132); 14. Height of chalk board above floor (p. 132); 15. Color and light reflective factor of walls (p. 133); 16. Color and light reflective factor of ceilings (p. 134); 17. Glossy finish prohibited (p. 134); 18. Provision of coatrooms, wardrobes, or lockers (p. 135).

TABLE 14--Continued

Recommendations of the National Council by Number*

Doors	Chalk Boards			Color of Walls and Ceilings			Coatroom, Wardrobes and Lockers	Total
11	12	13	14	15	16	17	18	
.	x	x	x	.	.	.	x	8
x	.	x	x	.	.	x	.	3
x	.	.	.	.	.	.	.	1
x	x	.	x	x	x	x	.	13
x	.	x	x	x	x	x	x	12
.	.	.	.	.	.	.	x	5
.	.	.	.	.	.	.	x	3
x	.	.	.	x	x	.	x	3
.	.	.	x	x	x	x	x	12
x	.	x	x	x	x	x	.	7
.	.	.	.	.	.	.	x	9
.	.	.	.	.	.	.	x	4
.	.	.	.	x	x	x	x	5
.	.	.	.	.	.	.	.	1
.	x	x	x	.	.	.	x	6
.	.	.	.	.	.	.	x	1
.	.	.	.	.	.	.	.	2
.	.	.	.	.	.	.	.	5
x	x	x	x	x	x	x	x	2
.	.	.	.	x	x	.	x	13
.	.	.	.	.	.	.	.	2
.	.	.	.	.	.	.	.	1
.	.	.	.	x	x	.	.	1
.	x	x	x	.	.	.	x	5
.	.	.	.	.	.	.	x	9
x	.	x	x	x	.	.	x	5
	.	x	x	x	x	x	x	13
8	5	8	10	9	9	8	18	...

and such other special features as the school organization may require.

Only three states have requirements making provisions for special features of this kind. As with the first recommendation, not all states include in their requirements all the items found in the recommendation of the National Council. However, some of the items are found in the requirements of the three following states, Connecticut, Delaware, and Kentucky.

It is evident, from the very few states with requirements for special features of construction and equipment, that throughout the country little attention and emphasis is given to the details of classroom planning and construction by responsible state agencies.

Dimensions of Classrooms

Five recommendations relating to the dimensions of classrooms are made by the National Council. A relatively large number of states have requirements of this kind.

3. That the width of a classroom, unilaterally lighted, be not more than twice its height.

The fifteen states listed below have requirements of this nature. In some instances when the width is specified in terms of feet, it has been necessary to interpret these requirements in light of the requirements specifying the height of the room.

1. Alabama--minimum 20 ft., maximum 22 ft.
2. Connecticut--width twice the distance from top of windows to floor.
3. Delaware--approximately 23 ft.
4. Florida--same.
5. Kentucky--same.
6. Maine--maximum 23 ft.
7. Maryland--same.
8. Massachusetts--not more than $2\frac{1}{3}$ times its height if lighted from one side only.
9. Ohio--same.
10. Pennsylvania--minimum 22 ft., maximum 24 ft.
11. South Carolina--same.
12. Texas--same unless adequate skylights are provided.
13. Virginia--same.

14. West Virginia--same.

15. Wisconsin--22 to 23 ft. If lighting is bilateral width may be $2\frac{1}{2}$ times the height.

This tabulation shows that where requirements are established, they almost without exception, meet the standards established in the recommendation of the National Council.

4. That, in general, the height of a classroom be twelve feet.

Fifteen states have requirements specifying either the height or a minimum height for classrooms.

1. Alabama--12 ft. standard, minimum 11 ft.
2. Connecticut--not less than 11 ft. 6 inches.
3. Florida--same.
4. Idaho--11 ft.
5. Kentucky--11 ft.
6. Maine--same.
7. Maryland--12 ft. 6 inches.
8. New Jersey--same.
9. North Dakota--same.
10. Ohio--10 ft.
11. Pennsylvania--11 ft.
12. Vermont--same.
13. Virginia--same.
14. West Virginia--same.
15. Wisconsin--same.

It may be noted that the minimum height varies from ten feet to twelve and one-half feet. While this is a relatively small variation, it is highly significant when related to classroom width and fenestration. A minimum height of twelve feet is not only found in the recommendation but is required in nine states. It appears that it would be the most acceptable standard and that a lesser height is likely to made inadequate provision for proper natural lighting on the corridor side of the room.

5. That the length of a classroom be determined by the desired seating capacity of the room.

Ten states have requirements relating to the length of classrooms. Those states specifying length in terms of feet, in every case, fail to specify whether the classroom is for use by elementary pupils or high school pupils. It would seem that

wherever a standard length is specified that it is for an elementary classroom. It would be difficult to provide any reasonable standard for other than elementary rooms. The following states have requirements as indicated.

1. Alabama--minimum 28 ft., maximum 30 ft.
2. Connecticut--same.
3. Delaware--31 ft., high school rooms may be smaller.
4. Kentucky--same.
5. Maine--ratio with width of 4 to 3. Maximum 32 ft.
6. Maryland--standard length 29 ft.
7. Pennsylvania--same. Minimum of 24 ft.
8. Virginia--same.
9. West Virginia--same.
10. Wisconsin--31 to 32 ft.

A requirement based on the seating capacity needed or desired would seem to be the most reasonable and useful.

6. That there be provided in the front end of the classroom approximately eight feet between the first row of seats and the front wall.

Only the three following states have requirements specifying the minimum distance between the first row of seats and the front wall.

1. Florida--minimum 4 ft.
2. Ohio--minimum 6 ft.
3. Pennsylvania--minimum 8 ft.

It is probable that the small number of states with minimum requirements of this nature may be explained by the rather frequent use of movable seating employed in recent years.

7. That in the rear of the classroom there be provided at least three feet between the last row of seats and the rear wall.

No state has any requirement of this kind in effect.

Seating Capacity of Classrooms

8. That the seating capacity of classrooms be determined by allowing a minimum of eighteen square feet per pupil, and such additional space as may be required for the educational activities of the school.

Seventeen states have requirements specifying the minimum square feet per pupil. However, only one state, Connecticut, stipulates any additional space for the educational activities of the room. Thirteen states have established minimums for the cubic feet of air space on a per pupil basis.

1. Connecticut--20 sq. ft. for high school rooms; 25 sq. ft. for elementary school rooms.
2. Delaware--18 sq. ft.; 200 cu. ft. per pupil.
3. Idaho--18 sq. ft. per pupil.
4. Kentucky--15 sq. ft.; 175 cu. ft. per pupil.
5. Maine--18 sq. ft.; 216 cu. ft. per pupil.
6. Maryland--16 sq. ft. per pupil.
7. Michigan--20 sq. ft.; 200 cu. ft. per pupil.
8. Montana--15 sq. ft.; 200 cu. ft. per pupil.
9. New Jersey--18 sq. ft.; 200 cu. ft. per pupil.
10. North Dakota--12 sq. ft.; 200 cu. ft. per pupil.
11. Oklahoma--15 sq. ft.; 200 cu. ft. per pupil.
12. South Carolina--16 sq. ft.; 200 cu. ft. per pupil.
13. South Dakota--15 sq. ft.; 216 cu. ft. per pupil.
14. Vermont--18 sq. ft.; 200 cu. ft. per pupil.
15. Virginia--15 sq. ft.; 200 cu. ft. per pupil.
16. West Virginia--15 sq. ft. per pupil.
17. Wisconsin--18 sq. ft. per pupil.

This tabulation reveals that six states require a minimum of eighteen square feet per pupil. Two states, Connecticut and Michigan, require a minimum of twenty square feet per pupil. North Dakota requires a minimum of only twelve square feet. The balance of the sixteen states have either fifteen or sixteen square feet as a minimum requirement. Only one state, Connecticut, has separate requirements for elementary and high school classrooms.

It is evident that considerable concern is manifest in these several states for the prevention of overcrowded rooms. Furthermore, the relatively large number of states with minimum requirements in terms of cubic feet of air space per pupil indicates a wholesome concern for health and sanitation.

Aisles

Standards have been established by the National Council

for regulating the width of both aisles next to walls and the intermediate aisles.

9. That for the safety and convenience in passing up and down the classroom, aisles next to walls be at least thirty inches wide.

Only three states have minimum requirements corresponding to this requirement.

1. Massachusetts--36 inches for aisles next to windows and 30 inches for inside aisle.
2. Ohio--28 inches for primary rooms.
30 inches for grammar grade rooms.
36 inches for high school rooms.
3. Wisconsin--36 inches.

10. That intermediate aisles be at least eighteen inches wide.

Only those three states with minimum requirements for outside walls have requirements for intermediate walls.

1. Massachusetts--17 inches.
2. Ohio--17 inches for primary rooms.
18 inches for grammar grade rooms.
20 inches for high school rooms.
3. Wisconsin--18 inches for elementary school rooms,
20 inches for high school rooms.

It is strange that so few states have established minimum requirements of this nature. This lack of regulation may be accounted for by the general use of movable classroom seating. However, it appears that there should be established minimum requirements of this kind in the interest of safety, applying specifically wherever fixed seating is to be installed.

Doors to Classrooms

11. That classroom doors be at least three feet by seven feet by one and three-quarters inches. A clear wire glass pane in the upper part of the door is a desirable feature.

Eight states have requirements specifying at least one of the dimensions of classroom doors. Only four states require a glass pane and only one of these specifies that it must be of wire glass.

1. California--3 ft. wide.
2. Connecticut--3 ft. by 6 ft. 10 inches by 1 3/4 inches. Glass pane recommended.

3. Delaware--3 ft. by 7 ft. Upper half shall be of clear glass.
4. Florida--3 ft. by 7 ft.
5. Kentucky--3 ft. by 6 ft. 8 inches.
6. Maryland--3 ft. in width. Wire glass pane of at least 12 x 12 inches.
7. Pennsylvania--3 ft. by 7 ft. Glass area in upper portion of not more than 280 sq. in.
8. Wisconsin--3 ft. by 7 ft.

It would seem that a greater number of states would have adopted minimum requirements relating to a building factor so essential to safety. While specifications for doors constitutes but a detail of total classroom planning, it is, however, a highly important factor in relation to safety. It seems unwise to rely on such standardization as may be established by custom for the usual millwork.

Chalk or Crayon Boards

Three recommendations designed to provide for an adequate amount of chalk board, and specifying width and the height of installation are made by the National Council.

12. That sufficient chalk or crayon board be provided for the teacher's use.

This recommendation is of such a general nature that in reality it does little more than provide for the installation of such board. It is obvious that the amount one teacher might consider sufficient, another teacher might consider highly inadequate. The following states have requirements similar to this recommendation of the National Council.

1. Alabama--same.
2. Connecticut--at least 10 to 20 lineal feet to be installed in front of room.
3. New Jersey--same.
4. Pennsylvania--30 to 35 lineal ft.
5. Virginia- 20 to 40 lineal ft.

While ten states have requirements specifying the height for installation, only five states have requirements relating to the amount.

Such requirements as are to be found, except in the instance of Pennsylvania, allow considerable latitude. The data

found preclude drawing any generalization.

13. That chalk or crayon boards be not more than forty-two inches in width.

Eight states have requirements concerning the width of chalk boards. However, most requirements specify an exact width rather than a maximum, while Maryland's specifies only a minimum.

1. Alabama--same.
2. Arkansas--same.
3. Delaware--48 inches.
4. Maryland--not less than 36 inches.
5. New Jersey--48 inches.
6. Pennsylvania--36 inches through grade IV and 42 inches for grades V and up.
7. Virginia--36 inches through grade VII; 48 inches for high school rooms.
8. Wisconsin--48 inches.

A variation from thirty-six to forty-eight inches is found, a greater width usually being specified for the upper grades. The maximum of forty-two inches specified in the recommendation of the National Council does not generally prevail.

14. That the height of the chalk trough above the floor be for:

First and Second Grades--24 to 28 inches.

Third and Fourth Grades--26 to 30 inches.

Fifth and Sixth Grades--28 to 32 inches.

Junior and Senior High Schools--30 to 36 inches.

Ten states have requirements specifying the height of installation. However, the same grade classifications as found in the above recommendation is not employed in all these requirements.

States	Grades	Height in Inches
1. Alabama	I through VI	26
	Junior High School	30
	Senior High School	34
2. Arkansas	I and II	26
	III and IV	28
	V and VI	30
	Jr. and Sr. High School	34
3. Connecticut	Kindergarten through III	26 to 30
	IV through VI	30 to 33
	Junior High School	33 to 36
	Senior High School	36 to 39

States	Grades	Height in Inches
4. Delaware	I and II	24
	III and IV	26
	V and VI	28
	VII and VIII	30
	High School	32
5. Kentucky	I and II	24 to 26
	III and IV	26 to 28
	V and VI	28 to 30
	VII and VIII	30 to 32
6. Maryland	I and II	24
	III and IV	26
	V and VI	28
	Jr. and Sr. High School	32 to 36
7. New Jersey	I through IV	26
	V through VIII	30
8. Pennsylvania	Kindergarten	21
	I and II	24
	III and IV	27
	V and VI	30
	Junior High School	32 to 36
	Senior High School	36 to 42
9. Virginia	I and II	26
	III and IV	28
	V through VII	31
	High School	36
10. Wisconsin	All Grades	Nor less than 24

This tabulation shows a considerable degree of uniformity in heights. A few states allow a range in height of installation. All others specify the exact height at the several grade levels. A considerable degree of uniformity is found, and, in general, the heights specified fall within the limits set up in the recommendation.

Color of Walls and Ceilings

The National Council makes three recommendations relating to the color and finish of walls and ceilings.

15. That upper walls be of a color with a light reflecting factor of fifty to sixty per cent.

Nine states have requirements relative to the color of walls although few make any reference to the light reflecting factor.

1. Connecticut--sufficient light reflecting factor.
2. Delaware--light buff, light cream, or light gray.

3. Indiana--neutral color.
4. Kentucky--light reflecting factor of 52%-78%.
5. Maine--light reflecting factor of at least 50%.
6. Michigan--light color and dull finish.
7. Pennsylvania--good reflection. Light buff, bright sage and ivory tan or silver gray and caen stone.
8. Vermont--light gray, buff, or greenish tint.
9. Wisconsin--light reflecting factor of 45%-60%.

16. That in all cases the ceiling be white, ivory, or light cream with a light reflecting factor of seventy-five to eighty per cent.

The same states with requirements concerning the color and finish of walls have additional requirements concerning the color and finish of ceilings.

1. Connecticut--light reflecting factor of not less than 60%.
2. Delaware--white or light cream.
3. Indiana--neutral color.
4. Kentucky--ivory white or light cream.
5. Maine--light reflecting factor of 80%.
6. Michigan--light color, dull finish.
7. Pennsylvania--ivory, ivory white, or pearl gray.
8. Vermont--light gray, buff, or greenish tint.
9. Wisconsin--light reflective factor of 75%.

17. That glossy finish be avoided.

The following eight states have requirements either prohibiting glossy finish for walls and ceilings or specifying dull finish.

- | | |
|----------------|-----------------|
| 1. Arkansas | 5. Maine |
| 2. Connecticut | 6. Michigan |
| 3. Delaware | 7. Pennsylvania |
| 4. Kentucky | 8. Wisconsin |

It is surprising that so few states have requirements concerning the color and light reflecting factor of wall and ceiling finish, inasmuch as these factors are as directly related to adequate and safe lighting as is proper fenestration and adequate artificial illumination. Requirements in general seem to meet the recommendation of the National Council in the several states wherever they are in effect.

It would seem that proper requirements should be established in all states to insure satisfactory finish of classrooms. The effects of adequate illumination, both natural and artificial, can be to a great extent nullified by improper finish of walls and ceilings.

Coatrooms, Wardrobes, and Lockers

18. That each elementary classroom provide suitable space for the children's outer garments in one of three ways:

- a. Ventilated coatrooms approximately five feet wide, with an outside window having a glass area of not less than one square foot to every ten square feet of floor area; also with two hook strips placed respectively three and one-half and five feet above the floor, each to be equipped with a sufficient number of hooks staggered eighteen inches apart on each strip. A pole equipped with hangers may be substituted for hook strips. Coatrooms as described above with a classroom wall in the form of a stationary screen are acceptable when the area behind the screen is properly ventilated.
- b. Ventilated wardrobes easy of access and convenient for use, opening preferably into the classroom.
- c. Ventilated lockers in corridors, providing ample space for outer garments and placed so as to be convenient for use.

Eighteen states have requirements specifying that provision be made for children's outer garments by one or more of the foregoing plans or facilities. However, few requirements are as detailed in the specifications as is the recommendation.

1. Alabama--a. coatrooms.
c. Lockers for high schools.
2. Connecticut--a. coatrooms, 3 ft. in width exclusive of hanging rooms for garments, independently ventilated
b. wardrobes.
c. lockers for high schools only.
3. Delaware--a. coatrooms.
b. wardrobes.
c. lockers.
4. Florida--a. coatrooms.
b. wardrobes.
c. lockers.
5. Idaho--a. coatrooms, at least 6 ft. wide.
c. lockers.

6. Indiana--a. coatrooms, well lighted, warmed and ventilated.
c. lockers.
7. Kentucky--a. coatrooms.
b. wardrobes.
c. lockers for high schools only.
8. Maryland--a. coatrooms; two 3 ft. doors required.
b. wardrobe.
c. lockers for high schools only.
9. Massachusetts--a. coatrooms, properly ventilated by flues.
10. Michigan--a. coatrooms.
b. wardrobes.
Separate rooms not in connection with classrooms may be provided.
11. New Jersey--a. coatrooms, well lighted and ventilated of sufficient size.
12. New York--a. coatrooms.
b. wardrobes.
c. lockers.
13. Oklahoma--a. coatroom, ventilated.
14. Pennsylvania--a. coatroom, 4 1/2 ft. wide.
b. wardrobes.
c. lockers.
15. Vermont--a. coatroom, properly ventilated and lighted.
16. Virginia--a. coatrooms, for elementary schools.
b. wardrobes, for both elementary and high schools.
c. lockers, for high schools only.
17. West Virginia--a. coatrooms, properly ventilated.
b. wardrobes, properly ventilated.
c. lockers, properly ventilated.
18. Wisconsin--a. coatrooms, properly ventilated.
b. wardrobes, properly ventilated.
c. lockers, properly ventilated.

It should be noted that all eighteen requirements include coatrooms for outer garments. Twelve states include wardrobes as an alternate provision. Thirteen states include lockers. However, five of the thirteen specify the use of lockers for high schools only. The fact that only eighteen states have requirements relating to such an essential feature as provision for outer clothes leads one to the conclusion that states without such requirements regard such specifications as unnecessary, probably assuming that such provisions are always made in school-house planning and construction.

Summary

It has already been pointed out that in most states where requirements exist they are insufficient in number to constitute complete codes. As a general rule the requirements that exist establish standards that substantially equal those established by the recommendations of the National Council.

Rather small variations in the dimensions of width and height requirements are found. The usual requirements for width and height limit the width of the classroom to not more than twice the height. This is in keeping with the recommendation of the National Council and is accepted as desirable practice.

Seven states specify a minimum length for classrooms in terms of feet. This is no doubt a useful provision. However, over and above this minimum it would be desirable to require that the length be determined by the seating capacity. Inasmuch as a minimum floor area per pupil is a requirement in many states, the room capacity becomes fixed if the length is specified, precluding any great flexibility for meeting unforeseen situations. Only if the classroom length is based on a possible maximum room occupancy or seating capacity can flexibility be secured for meeting new conditions that may obtain in the future.

Few states have requirements corresponding to the recommendations of the National Council specifying minimum distances of seating from front and rear walls, or specifying minimum width of aisles. In view of the widespread use of movable seating it would seem reasonable for the National Council to stipulate that these recommendations apply only where fixed seating is to be used.

Wide variation is noted in the state requirements establishing a minimum of square feet of floor area per pupil. The range is from a low of twelve to a high of twenty-five. The requirements in eight states either equal or exceed the eighteen square feet recommended by the National Council. Only one state permits fewer than fifteen square feet. Such requirements are based on two factors, adequate area for instructional purposes and the maintenance of hygienic and healthful conditions. The higher minimums are certainly desirable for the first of these two factors. A desirable and adequate minimum for reasons of health would depend upon the system of ventilation and possibly other factors. As yet data are not available to determine this.

However, it seems safe to conclude that a minimum of less than eighteen square feet is inadequate for a modern program of instructional activities.

Twelve of the seventeen states with requirements establishing a minimum of floor area per pupil also specify a minimum of cubic feet per pupil. The range is from one hundred and seventy-five to two hundred and sixteen, with two hundred the usual requirement. In view of the fact that a ceiling height of more than twelve feet is required for any area of less than seventeen square feet of floor area in order to obtain two hundred cubic feet, it is apparent that either a ceiling height of more than twelve feet, or a minimum of seventeen square feet of floor area must be required. It is difficult to reconcile these several requirements in certain of the states.

Where dimensions of classroom doors are specified they are uniform and equal to the three feet recommended by the National Council.

Small variations only are found in the requirements fixing the height of blackboards, and as a rule the heights specified fall within the limits recommended by the National Council.

Only a few states specify either a non-glossy finish for walls and ceilings or a color providing a minimum light reflecting factor. Such requirements are not only highly desirable but essential in order to make provision for adequate illumination, and illumination which is not harmful.

Requirements making provision for pupils' outer garments are usually adequate and correspond to common practices.

There is a real need for more complete codes and in many instances an upgrading of requirements establishing minimum standards for classroom planning and construction.

CHAPTER IX

AUDITORIUMS

A list of ten recommendations for the planning and construction of auditoriums has been adopted by the National Council on Schoolhouse Construction. Inasmuch as a number of these recommendations are designed to insure safety to the occupants, and inasmuch as a number of states have requirements governing the construction of auditoriums, it seemed desirable to include this subject in the investigation.

Eighteen states have minimum requirements corresponding to one or more of the recommendations of the National Council.

Table 15 shows the states having requirements corresponding to the recommendations of the National Council relating to auditoriums.

An analysis of this table shows that few requirements have been adopted for factors other than exits and locations. As might be expected, requirements which have the most obvious bearing on safety are most frequently found.

There is an obvious lack of completeness in the codes governing the construction of auditoriums. Only three states, Connecticut, Virginia, and Wisconsin have requirements corresponding to as many as half of the thirteen recommendations made by the National Council on Schoolhouse Construction. Virginia has eight such requirements and Connecticut and Wisconsin each seven. The need for requirements relating to those aspects of construction so commonly ignored in the codes is obvious.

The following tabulations compare the state requirements with the recommendations of the National Council.

Location

1. That the auditorium be located so that it furnishes easy and quick access to students and with its main floor as close to grade as feasible.

Ten states have requirements similar to at least one of

TABLE 15

STATES HAVING REQUIREMENTS CONCERNING AUDITORIUMS
CORRESPONDING TO THE RECOMMENDATIONS
OF THE NATIONAL COUNCIL

States	Recommendations of the National Council by Number*													
	Location	Exits		Proportions	Capacity	Stage		Aisles		Seating		Choice of Materials	Projector Room	Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	
Alabama.....	x	x	x	.	x	.	.	.	.	.	.	.	.	4
California.....	.	.	x	.	x	.	.	.	.	.	.	.	x	3
Colorado.....	.	.	.	.	.	.	.	x	x	x	x	.	x	5
Connecticut...	x	x	x	.	x	x	x	.	.	.	.	.	x	7
Delaware.....	x	x	.	.	.	.	.	.	.	.	.	.	x	3
Florida.....	x	.	.	.	.	.	.	.	.	.	.	.	x	2
Idaho.....	x	x	.	.	.	.	.	.	.	.	.	x	.	3
Illinois.....	.	.	x	.	.	.	.	.	.	.	.	.	.	1
Kentucky.....	x	x	x	.	.	x	.	.	.	.	.	.	.	4
Maryland.....	x	x	x	.	x	.	.	.	.	.	.	.	x	5
Massachusetts.	.	x	x	.	.	.	.	.	.	.	.	.	.	2
New Jersey....	.	.	x	.	.	.	.	.	.	.	.	.	.	1
Pennsylvania..	x	x	x	.	.	.	.	.	.	.	.	.	.	3
South Carolina	.	x	x	.	.	.	.	.	.	.	.	.	.	2
Vermont.....	.	.	.	.	x	.	.	x	x	x	.	.	.	4
Virginia.....	x	.	x	.	x	.	.	x	x	x	x	x	.	8
West Virginia.	x	.	x	.	x	.	.	.	.	.	.	x	.	4
Wisconsin.....	.	x	x	.	x	.	.	x	x	x	.	.	x	7
Total.....	10	10	13	0	8	2	1	4	4	4	2	3	7	...

* 1. Location (p. 139); 2. Minimum of 2 exits (p. 141); 3. Number of exits (p. 141); 4. Ratio of length to width (p. 143); 5. Capacity in terms of sq. ft. per person (p. 143); 6. Minimum depth of stage (p. 143); 7. Minimum depth of stage in high schools (p. 144); 8. Width of aisles with seats on both sides (p. 144); 9. Width of aisles with seats on one side (p. 144); 10. Distance of seats back to back (p. 145); 11. Width of seats (p. 145); 12. Acoustical treatment (p. 145); 13. Construction and ventilation of projector room (p. 145).

the provisions contained in this recommendation.

1. Alabama--prohibited above the second story.
2. Connecticut--same. Not more than 6 ft. above or below grade level.
3. Delaware--same.
4. Florida--if seating capacity is more than 500, it must be located on main floor unless the building is fire-resistive.
5. Idaho--located on ground level.
6. Kentucky--located on first floor.
7. Maryland--located on ground floor unless that portion of the building containing the auditorium and its exits is of fire-resistive materials.
8. Pennsylvania--same. Cannot be above first floor level or below grade level.
9. Virginia--same. Prohibited above second story.
10. West Virginia--same.

It should be noted that the phrase "as close to grade as feasible" contained in the recommendation of the National Council is highly indefinite. As nearly as can be determined, the requirements in effect in the above ten states seem to conform to the intent of the recommendation. In addition, several states have more specific limitations concerning the location of auditoriums in relation to the ground level or first floor.

Exits

Two recommendations are found concerning exit requirements.

2. That all auditoriums regardless of capacity shall be provided with not less than two exits which shall be remote from each other.

Ten states require at least two exits:

- | | |
|----------------|-------------------|
| 1. Alabama | 6. Maryland |
| 2. Connecticut | 7. Massachusetts |
| 3. Delaware | 8. Pennsylvania |
| 4. Idaho | 9. South Carolina |
| 5. Kentucky | 10. Wisconsin |

In addition, Massachusetts and Wisconsin specify at least two exits from the balcony or gallery.

3. That regardless of the location of the auditorium, there be entrance and exit facilities to provide amply for the

number of persons for whom the auditorium has seating capacity. In general, the provisions of the current Building Exits Code of the National Fire Protection Association shall govern.

1. Alabama--same.
2. California--22 inches for each 100 occupants.
3. Connecticut--one additional exit to the regular building exits for each 600 sq. ft. of floor area. Exits shall be distributed for ready means of egress.
4. Illinois--5 ft. for each 100 occupants.
5. Kentucky--22 inches per each 100 occupants.
6. Maryland--same.
7. Massachusetts--same.
8. New Jersey--ample means of egress.
9. Pennsylvania--a. If exits are not more than 8 inches above grade:

Capacity

Fire-Resistive Buildings	Non Fire-Resistive Buildings	No. of Exits
Up to 100	Up to 100	2
101 to 400	101 to 350	3
401 to 600	351 to 500	4
For each 250 persons or fraction thereafter	For each 200 persons or fraction there- after	Add 1

b. If exits are more than 8 inches

above grade:

Up to 100	Up to 100	2
101 to 250	101 to 200	3
251 to 500	201 to 400	4
For each 250 persons or fraction thereafter	For each 250 persons or fraction thereafter	Add 1

10. South Carolina--one exit for each 250 persons.
11. Virginia--same.
12. West Virginia--must be possible to vacate it in two minutes.
13. Wisconsin--36 inches per 100 persons in fire-resistive construction, 40 inches in ordinary construction, and 44 inches in frame construction.

Only a few states specify that exit facilities shall be governed by the Building Exits Code of the National Fire Protection Association, although most requirements meet the standards established in this Code. Most of the requirements are

specific in nature. However, West Virginia and New Jersey are exceptions in this respect, the former requiring only that the auditorium may be evacuated in at least two minutes, and the latter that there be ample means of egress. It may be noted also that requirements in some instances vary widely, Illinois requiring five feet of exit per one hundred occupants, while California and Kentucky require but twenty-two inches per hundred occupants.

Proportions

4. That the distance from the stage to the front entrance be not more than three times the width.

No state requirements of this kind are in effect.

Capacity

5. That the capacity of an auditorium be computed on the basis of from six to seven square feet of floor area per person.

The eight following states have requirements of this nature.

1. Alabama--6 1/2 sq. ft.
2. California--7 sq. ft.
3. Connecticut--6 to 7 sq. ft.
4. Maryland--6 sq. ft.
5. Vermont--6 sq. ft.
6. Virginia--6 1/2 sq. ft.
7. West Virginia--6 1/2 sq. ft. if straight rows of seats; 7 1/2 sq. ft. if curved rows of seats.
8. Wisconsin--7 sq. ft.

All eight state requirements meet the standard contained in the recommendation of the National Council.

Stage

Two recommendations relating to the depth of the stage are made by the National Council.

6. That the minimum clear depth of a stage be twenty feet, measured between proscenium wall and rear wall of stage.

Connecticut and Kentucky, the only states with requirements concerning depth of stage, require a minimum of eighteen and sixteen feet, respectively.

7. That for high schools and other schools where conditions warrant, the stage depth be increased to twenty-five feet or more.

Connecticut is the only state having a requirement specifying the same identical measurement.

Aisles

The National Council makes two recommendations governing width of aisles, one applies to aisles with seats on both sides and the other to aisles with seats on but one side.

8. That aisles with seats on both sides have a minimum effective width of not less than three feet at the beginning and increased one and one-half inches for each five running feet.

It is difficult to understand why only four states have minimum requirements for width of aisles, inasmuch as this is a highly important factor of safety. The following states have minimum requirements as listed below.

1. Colorado--2 1/2 ft. and not more than 14 seats between aisles.
2. Vermont--3 1/2 ft. and not more than 14 seats between aisles.
3. Virginia--same. Not more than 15 seats between aisles.
4. Wisconsin--2 ft. 10 in. and increased 2 1/2 in. for each 10 running ft. Not more than 12 seats between aisles.

9. That aisles with seats on one side only have a minimum effective width approximately two and one-half feet at the beginning and increased in width one and one-half inches for each ten running feet.

1. Colorado--2 1/2 ft. and not more than 7 seats served by such aisle.
2. Vermont--2 ft. and not more than 7 seats served by such aisle.
3. Virginia--same. Not more than 7 seats served by such aisle.
4. Wisconsin--no wall aisle less than 3 ft. Not more than 6 seats served by such aisles.

It should be noted that all of these requirements are definite and specific though in the instances of Colorado and Vermont, the requirements are not equal to the standard established by the recommendations.

Seating

The National Council has adopted two recommendations concerning auditorium seating.

10. That standard seating be thirty-two inches from back to back.

The only states with requirements of this kind are the same four with requirements establishing minimum widths for aisles.

1. Colorado--30 in.
2. Vermont--30 in. Balcony platforms shall also be 30 in. in width.
3. Virginia--32 in.
4. Wisconsin--32 in.

11. That width of seats be from nineteen to twenty-four inches.

Only two states have minimum requirements for width of seats.

1. Colorado--minimum width 18 in.
2. Virginia--minimum width 19 in.

Choice of Materials

12. That such materials be used on the walls, the ceiling, and the furnishings of the auditorium as will result in good acoustical properties.

This recommendation is very general and would seem to be unnecessary, as it should be safe to assume that good acoustical properties would be an objective in all instances. However, the following three states have requirements similar to the recommendation; Idaho, Virginia, and West Virginia.

Projector Room

13. That if a projector room is provided, it shall be fireproof with mechanical ventilation.

Six states have requirements relating to projector rooms or motion picture enclosures.

1. California--concrete floor or covered with at least 2 inches of masonry. Walls and ceiling of one-hour fire resistive construction. Equipped with automatic shutter.

2. Colorado--fire resistive construction with automatic shutters.
3. Connecticut--fireproof construction.
4. Delaware--ventilated in accordance with standard requirements of the National Board of Fire Underwriters.
5. Florida--must conform to the rules of the National Board of Fire Underwriters.
6. Maryland--fire resistive construction of at least 4 hour rating.
7. Wisconsin--floor and ceiling of concrete. Walls and ceiling of at least 2 hour fire resistive construction.

Few of these requirements make provision for both fireproof construction and mechanical ventilation.

Summary

It has been pointed out that a total of eighteen states have requirements corresponding to one or more of the ten recommendations advanced by the National Council concerning auditoriums. Only those requirements concerned with two factors, namely location of the auditorium and exit facilities, are found in sufficient number to be significant. A total of ten states have requirements relating to location, and fifteen have requirements relating to exit facilities. Minimum requirements of these two kinds establish standards substantially equal to the recommendation of the National Council which specifies that the provisions of the Building Exit Code of the National Fire Protective Association shall govern for the second of these factors. While only four states specify the Building Exit Code, requirements in other states are, as a rule, equal or higher than the provisions of the code. A wide variation in requirements exists while a few requirements are stated in such general terms as to be meaningless.

The number of requirements concerned with proportions of the auditorium, stage, aisles, seating, and materials is insignificant. In the few instances where states have enacted such requirements they vary little from the National Council recommendations.

Seven states have requirements specifying either fireproofing or fire-resistive construction for the projection room, whereas the recommendation of the National Council is for fire-

proof construction.

It is difficult to understand why so few states have adopted requirements for auditoriums inasmuch as safety for gatherings of this kind is highly important. A possible explanation may be that in many of the states, as is true in some, the code governing theatres also applies to school auditoriums.

The number of requirements in most of the states is so few as to provide only fragmentary and incomplete codes. However, it is commendable that those factors contributing most to safety are most frequently the subject of minimum requirements.

CHAPTER X

SUMMARY AND CONCLUSIONS

The findings relative to the three purposes of the study are summarized in this chapter. Conclusions or generalizations which the data warrant are set forth in answer to the questions raised in the introduction.

Analysis and Comparison of State Requirements

1. Thirty-five states have established legal minimum requirements for materials and specifications to be employed in the erection or alteration of school buildings, and for school sites. All such requirements were obtained and used in this investigation excepting those in one state, Minnesota, where it proved impossible to secure the requirements.

Thirteen states report that no legal requirements governing schoolhouse construction have been established.

In eighteen states, all or a part of such requirements are enacted by statutes.

In twenty-two states, all or a part of the requirements are established by rules and regulations of state agencies which have been charged with this responsibility and authority. Such requirements have the same effect as statutory regulations, although established by ministerial authority. Recommendations have been excluded in all instances, and the data include only the material embodied in actual requirements.

In six states requirements are of both kinds, statutory and regulations established by state agencies.

Minimum requirements relating to the twelve aspects or items of construction most commonly the subject of regulation were studied. These twelve aspects or items follow:

1. School grounds
2. Playgrounds and athletic fields
3. General construction
4. Corridors
5. Stairways
6. Exits
7. Sanitary facilities

8. Service systems
9. Fenestration
10. Artificial illumination
11. Classrooms
12. Auditoriums

2. The total number of requirements in effect concerning these twelve aspects of construction varies widely among the thirty-four states. Table 16 shows the total number of requirements established in each state. States are ranked according to this total.

TABLE 16

TOTAL NUMBER OF REQUIREMENTS REGULATING TWELVE ITEMS
OF CONSTRUCTION AND SITE IN 34 STATES

Rank	States	Number of Requirements
1	Connecticut	132
2	Virginia	91
3	Maryland	81
4	Pennsylvania	78
5	Delaware	72
6	Kentucky	72
7	Wisconsin	72
8	Florida	59
9	Idaho	54
10	Ohio	47
11	California	46
12	Alabama	42
13	West Virginia	39
14	New Jersey	37
15	Michigan	36
16	Vermont	33
17	South Carolina	30
18	Massachusetts	29
19	Maine	27
20	New York	21
21	Colorado	19
22	Illinois	16
23	Indiana	16
24	North Dakota	16
25	Texas	13
26	Montana	10
27	Oklahoma	8
28	Arkansas	7
29	South Dakota	6
30	Kansas	3
31	Arizona	2
32	Missouri	1
33	Nebraska	1
34	New Mexico	1

The table shows that the number of requirements varies from one to one hundred and thirty-two. The median number is between twenty-nine and thirty.

This wide range together with the difference in number in the instances of Connecticut and Virginia indicates an obvious need for more requirements in almost all of the states, if anything approaching adequate regulation is to obtain.

3. It is also significant to determine how many of the twelve aspects or items of construction are the subject of regulation in each of the states. This is shown in Table 17.

TABLE 17

NUMBER OF TWELVE ITEMS OF CONSTRUCTION FOR WHICH
REQUIREMENTS ARE ESTABLISHED BY 34 STATES

Rank	States	Number
1	Connecticut	12
2	Maryland	12
3	Pennsylvania	12
4	Virginia	12
5	Delaware	11
6	Florida	11
7	Kentucky	11
8	Massachusetts	10
9	Michigan	10
10	Vermont	10
11	Wisconsin	10
12	Alabama	9
13	California	9
14	Idaho	9
15	Maine	9
16	New Jersey	9
17	Ohio	9
18	West Virginia	9
19	New York	8
20	North Dakota	8
21	South Carolina	8
22	Colorado	7
23	Illinois	6
24	Indiana	6
25	Texas	5
26	Arkansas	4
27	Montana	4
28	Oklahoma	4
29	South Dakota	4
30	Kansas	3
31	Arizona	1
32	Missouri	1
33	Nebraska	1
34	New Mexico	1

Again a great variation is found to prevail. The range extends from one to twelve, the latter figure constituting the total number studied. The median number of items for which requirements are established in the thirty-four states is nine.

The data presented in Table 17 reveal a need for wider requirements on the part of many states. It is evident that many codes are inadequate even in providing minimum requirements for all of the aspects or items of construction which are most frequently considered proper subjects of regulation.

4. Another interesting comparison is made by showing the range in the number of requirements in effect in the states for each of the twelve aspects or items of construction included in the study. This range is shown in Table 18.

TABLE 18

RANGE IN NUMBER OF REQUIREMENTS CONCERNING
TWELVE ITEMS OF CONSTRUCTION IN 34 STATES

<u>Items</u>	<u>Range</u>
School Grounds	1 to 10
Playgrounds and Athletic Fields	1 to 4
General Construction	1 to 11
Corridors	1 to 8
Stairways	1 to 17
Exits	1 to 7
Sanitary Facilities	
Toilet Rooms and Fixtures	1 to 17
Drinking Fountains	1 to 6
Service Sinks	1 to 3
Showers	1 to 2
Service Systems	
Water Supply	1 to 2
Heating	1 to 3
Ventilation	1
Electric Service	1 to 6
Fenestration	1 to 11
Artificial Illumination	1 to 5
Classrooms	1 to 13
Auditoriums	1 to 7

Here again wide variations are observed to exist. It is evident that great variations not only exist among the states in the items that are the subject of regulation but that great variation also exists in the completeness or coverage for each item. This table emphasized the fact revealed in Table 16,

namely, that there is need for a larger number of requirements in most of the states, if adequate codes are to be developed.

5. Further disparities are found in the standards which have been established by the requirements in effect in the several states. In some instances, a considerable degree of uniformity is found to prevail. However, there are rather wide variations in the standards established for the majority of the items or aspects of construction which are the subject of the requirements considered in the previous chapters of this study.

Comparison of Requirements with the Recommendations of the National Council on Schoolhouse Construction

In attempting to determine whether state requirements establish desirable and adequate standards, the latest published recommendations of the National Council on Schoolhouse Construction were employed. Reasons for selecting these recommendations as the most valid statement of standards is discussed on pages 7 and 8.

1. One measure of the adequacy of state requirements is a comparison of the number of requirements in effect for the twelve items studied with the number of National Council recommendations for these same items. Table 16 shows the total number of requirements by states for the twelve items or aspects of construction studied. As has been pointed out, the number of requirements ranges from one to one hundred and thirty-two. The median number is twenty-nine. The National Council has formulated a total of one hundred and sixty-four recommendations for these twelve phases of construction. It is true that a few of the recommendations are so general as to be of little or no value, that in several instances duplications in the recommendations are found to exist--and that in other instances recommendations are not well founded or are at least questionable. Nevertheless, it is evident that in the great majority of states, the school building codes are at best incomplete and fragmentary as compared with the recommendations of the National Council. There is apparently a great lag on the part of most states in implementing desirable and continually improving standards of schoolhouse construction.

Table 19 shows the number of requirements by states for each item or aspect of construction studied compared with the

corresponding number of recommendations made by the National Council on Schoolhouse Construction.

This table reveals that not only are there wide variations among the states in the number of requirements for each item, but also that the number of requirements in most of the states falls short of the number of recommendations made by the National Council. In fact, states with a number of requirements even approximating the number of recommendations are the exception rather than the rule. While there is a considerable variation in this respect among the several items, it is nevertheless unusual to find that fifty per cent of the states have requirements corresponding to as many as half of the recommendations of the National Council. The data presented in Table 19 further substantiate the conclusion previously drawn that, in the great majority of states, codes are incomplete and fragmentary.

Two kinds of deficiencies are clearly revealed. In the first place, few states have requirements relating to a sufficient number of items or aspects of planning and construction. It may be noted that Connecticut is the only state with requirements concerning all of the items studied. In the second place, among those states having requirements relating to these items or aspects of construction, few have a sufficient number of requirements to provide complete or adequate regulation.

There is a clear need for regulating more items or aspects of construction and more adequate regulations for the several aspects already the subject of requirements.

Another measurement of the adequacy of state regulation can be made by noting the number of states with requirements for each of these items or aspects of construction.

It should be noted (see Table 20) that fewer than half of the forty-eight states have requirements concerning more than six of the nineteen items. It is significant that as many as one-half of the thirty-four states with minimum requirements have requirements concerning not more than twelve of these nineteen items. The largest number of states with requirements concerning any of the items is twenty-nine, which is the number of states with requirements applying to exits.

The findings reveal a considerable lag between the development of adequate standards and the establishment of such standards as requirements in any large number of states.

TABLE 19

NUMBER OF REQUIREMENTS REGULATING EACH OF NINETEEN
ITEMS OF CONSTRUCTION AND SITE IN 34 STATES

Items or Aspects of Construction						
States	School Grounds	Playground and Athletic Field	General Construction	Corridors	Stairways	Exits
Alabama			3	5	8	2
Arizona				1		1
Arkansas					2	1
California			11	4	13	6
Colorado				1	4	2
Connecticut	10	4	8	7	17	7
Delaware	6		5	4	10	6
Florida	6		4	5	15	2
Idaho			6	6	13	7
Illinois			4	2	4	2
Indiana	2		2	2		
Kansas			1	1	1	
Kentucky	6		3	5	10	3
Maine	2			1	2	2
Maryland	7	1	9	7	12	4
Massachusetts			1	3	1	2
Michigan	3	1	6		1	3
Missouri						1
Montana	4					
Nebraska						1
New Jersey			6	2	10	2
New Mexico	1					
New York	3		1		4	1
North Dakota	1			2	3	3
Ohio	1		7	4	11	3
Oklahoma						1
Pennsylvania	9	2	9	4	14	6
South Carolina			6	4	7	2
South Dakota	2			1		
Texas				1	4	
Vermont	2	1		1	9	1
Virginia	2	3	4	8	11	7
West Virginia			3	2	8	5
Wisconsin			10	5	12	4
National Council Recommendations	12	6	14	8	17	8

TABLE 19--Continued

Sanitary Facilities				Service Systems					Penetration	Artificial Illumination	Classrooms	Auditoriums
Toilet Rooms and Fixtures	Drinking Fountains	Service Sinks	Showers	Water Supply	Heating	Ventilation	Electric Service	Service Rooms				
	1			1	1	1	1	1	6		8	4
4	1					1		1	1	1	3	
2	1				1	1	1	1	1	1	1	3
17	6	3	1	2	3	1	6	4	11	5	13	5
7	3		1		1	1	1	2	7	3	12	7
7	3		2			1	1	3	5	1	5	3
	3	2		2	1	1	1	2	4		3	2
						1	1	2			3	1
					1	1			5		3	
7	2	1		2	1	1	1	4	8	2	12	4
3					1	1			5	3	7	
6	2			1	2	1	1	3	8	3	9	5
5		1			1	1	1	3	2	2	4	2
4				2	1	1		1	5	3	5	
					1	1			3		1	
3					1	1		2	3		6	1
3					1	1		2	4		1	
1					1	1			2		2	
5	1	1		1	1	1	1	2	3		5	
						1			4		2	
2				2			1	2	7	4	13	3
						1	1	1	4		2	2
					1	1					1	
1				1	1	1			5		1	
19	6			1	2	1		3	5		5	4
5						1	2	3	6	1	9	8
3	1				2	1		2	6	1	5	4
									7	5	13	7
19	6	3	4	5	2	1	7	6	13	7	18	7

TABLE 20

NUMBER OF STATES HAVING REQUIREMENTS FOR EACH
OF NINETEEN ITEMS OF CONSTRUCTION

<u>Items of Construction</u>	<u>Number of States</u>
1. School Grounds	17
2. Playgrounds and Athletic Fields	6
3. General Construction	19
4. Corridors	26
5. Stairways	27
6. Exits	29
Sanitary Facilities	
7. Toilet Rooms and Fixtures	19
8. Drinking Fountains	11
9. Service Sinks	5
10. Showers	3
Service Systems	
11. Water Supply	10
12. Heating	20
13. Ventilation	25
14. Electric Service	14
15. Service Rooms	18
16. Fenestration	25
17. Artificial Illumination	14
18. Classrooms	27
19. Auditoriums	18

It is also true, as has been pointed out in the previous chapters that the standards established by the existing requirements are frequently not equal to those established by the recommendations of the National Council.

Requirements covering some factors in school plant planning and construction establish widely varying standards among the several states. Illustrative of this generalization are requirements establishing minimum areas of sites, specifications for corridor doors opening into stair enclosures, ratios of toilet fixtures per pupil, and floor areas per pupil. These illustrations might be multiplied. As a rule the less rigid requirements permit standards considerably below those established by the recommendations advanced by the National Council.

On the other hand, requirements concerning other factors establish relatively uniform standards among the states. Such instances may be illustrated by requirements for general construction of one-story buildings, minimum width of corridors, and

ratio of glass area to floor area in classrooms. Illustrations of this latter kind are fewer in number, however, than are those of rather widely varying standards. As a rule where a considerable degree of uniformity in standards is established, the standards are substantially equivalent to those set up in the recommendations of the National Council.

Only in the case of ventilation do state requirements as a rule establish standards exceeding that recommended by the National Council. However, it has been pointed out that state requirements concerning this item are in most instances questionable.

In a few instances requirements in one or more of the states, usually regulating a single aspect of construction, establish a standard clearly higher than that advocated by the National Council. Usually such standards involve an additional building cost, which may or may not be justified. While recommendations of the National Council are not based on infallible judgment, they are recognized as being the product of more mature deliberation on the part of a larger group of informed persons than are individual state requirements.

In only a very few states do a large majority of the requirements establish standards substantially equal to the standards embodied in the recommendations of the National Council. More typical is the situation where some standards are equivalent to those set up in the recommendations of the National Council and others are clearly lower.

Not only are codes too frequently fragmentary and incomplete with respect to requirements relating to a sufficient number of construction factors, but there is need for the upgrading of standards established for a number of these factors in most states, and for many of these factors in a number of states. Unsatisfactory standards result from both quantitative and qualitative inadequacies in requirements. Minimum requirements have not improved qualitatively as rapidly as additional research and knowledge would permit, and for some factors or areas apparently not as rapidly as current practice.

Comparison of the Adequacy of More Recently Adopted Codes with the Earlier Codes

A third purpose of this study, as stated in the introduction, was that of ascertaining whether any trends in certain as-

pects of schoolhouse construction might be identified by making a comparison of the more recently adopted codes with the later ones. Difficulties were encountered in this phase of the study which prevented the drawing of any final conclusions or generalizations in answer to the question raised.

In the first place, it was found that many of the statutory requirements are not dated. Where codes, if they may be called such, consist of statutes, it was discovered that the statutes were usually enacted at different times and that the codes were built up in piecemeal fashion. Apparently, there have been few revisions of statutory requirements.

Furthermore, it was found that where there are separate codes regulating different aspects of construction within a single state, these codes seldom were adopted at the same time. This is true whether the codes are a product of the same or of different state agencies.

In the light of the foregoing facts, it becomes impossible to make any comprehensive study of this aspect of the problem or to draw any but tentative conclusions.

However, with these limitations in mind, an attempt has been made to study this particular problem.

Following is listed all of the codes or requirements for which it is possible to determine dates of adoption. The list is arranged in the reverse order of adoption.

- 1944 Wisconsin--School Lighting Code.
- 1943 California--Uniform Building Code of the Pacific
Coast Building Officials.
Kentucky
- 1942 Colorado
Michigan--Requirements of Department of Health.
Wisconsin--Building Code.
- 1941 Connecticut
Maine
Maryland
Michigan- Statutory Requirements.
- 1940 Idaho
Ohio
- 1939 Florida
Pennsylvania
Virginia

- 1937 Vermont--Fire Escapes and Exits.
- 1936 Wisconsin--Heating, Ventilating and Air
Conditioning Code.
- 1935 North Dakota
- 1932 South Carolina
- 1931 Delaware
- 1929 Missouri
- 1928 Arizona
- 1925 Vermont--Department of Health Requirements.
- 1913 Texas

This tabulation and Table 16 show that with the exception of Colorado and Maine all states with codes known to have been enacted since 1937 have requirements that exceed the median number of requirements for all thirty-four states. The data also reveal that among the first eleven states ranked by total number of recommendations, all but one, Delaware, have codes adopted since 1937.

While the available data are too limited to warrant the drawing of a general conclusion, they do indicate that the more recent codes are more adequate and complete than those adopted earlier.

Further Conclusions Warranted by the Data

In addition to the conclusions previously stated in this chapter, the findings warrant the following additional generalizations.

1. Codes which are the product of state agencies are more complete and more nearly approach adequacy than those which are established by legislative enactment. The codes in the seventeen states with the largest number of requirements, with the exception of Florida and South Carolina, were formulated or adopted by state agencies. While it is true that there are statutory requirements in the instance of Pennsylvania, it is also true that the requirements of the agencies contributing to this code exceed the statutory provisions and form the great bulk of this code. The explanation of the inferiority of the statutory codes is the well-known fact that it is difficult to revise statutory requirements once enacted, and to establish new requirements by additional legislative enactment. This is, of course, occasioned by the usual difficulties and delay involved in the legislative

process. Furthermore, the wide and varied responsibility for legislation of all kinds incumbent on all state legislative bodies, allows little time or attention to be devoted to such specialized legislation as is involved in formulating an adequate code for schoolhouse construction. Once established by statute, it is difficult to secure sufficiently frequent revision to keep pace with continuously improving standards.

2. Minimum requirements are almost entirely directed at factors which establish or contribute to the safety and sanitation of the school building. This is no doubt as it should be inasmuch as the first consideration is to make buildings safe and healthful.

3. In general, very little attention or space is devoted to educational planning or to providing facilities that are essential for conducting a modern school program. Such areas as the library, laboratories, shops, offices, cafeterias, and other special work areas are ignored in almost all state codes. Requirements designed to provide for such educational features are found in only five states, namely; Alabama, Connecticut, Kentucky, Virginia, and West Virginia.

Table 21 shows the number of such educational features for which requirements have been established in these five states and the approximate percentage of the total code content devoted to requirements of this nature.

TABLE 21

NUMBER OF EDUCATIONAL FEATURES AND APPROXIMATE PERCENTAGE
OF TOTAL CODE CONTENT DEVOTED TO THESE FEATURES

States	Number of Features	Percentage of Content
Alabama.....	4	7
Connecticut.....	20	40
Kentucky.....	8	35
Virginia.....	3	12
West Virginia.....	2	10
National Council Recommendations....	23	45

It is disappointing to find that so few states have adopted requirements of this kind. Only two of the five states with such requirements have a percentage of the total that even approximates that of the National Council.

4. The influence of the work of the National Council on Schoolhouse Construction is clearly evident in a number of state codes; in some instances requirements are identical with the recommendations of the National Council.

5. While progress has been made in establishing sound minimum requirements in a sufficient number to constitute adequate codes in a few states, such progress has been disappointingly slow.

6. The improved codes developed in a few states should serve to stimulate the development of similarly improved codes in other states. Evidence of such is indicated by the fact that four states reported that either new codes or revision of existing codes are now being prepared, and one state with no code reported an unsuccessful attempt to have a code enacted by the state legislature in 1943.

7. A number of state codes, and portions of others, are unrealistic. This is due to obsolescence and the fact that there are great variations in local conditions which cannot be easily taken into account in blanket regulations.

In conclusion the question may well be raised as to how rigid and specific codes should properly be in order to serve well their purpose. This is a highly controversial question, for which there is no patent answer. Engelhardt states that regulations have tended to freeze building concepts into fixed moulds, but admits that they have been of great value in overcoming indifference and stupidity.¹

If flexibility and adaption to local needs are desirable, these factors may be hampered by a state code containing too many specifics. Highly specific codes become obsolete relatively fast, and difficulties of revision have already been pointed out, particularly if the requirements are statutory. As educational objectives and building technology change, highly specific codes

¹Nicholas L. Engelhardt, "The Impact of the War Upon School Building Planning," American School and University, pp. 13-20. New York: American School and Publishing Co., 1942.

tend to freeze building to the past levels of average practice. It is possible that rigid codes might prohibit any kind of building, inasmuch as a community might conceivably be unable to afford the kind of construction required by state code.

On the other hand, state codes which contain too few specifics may permit unsafe practices and in the end bring an undesirable reaction. When the result is a local catastrophe because of too few or too lenient requirements the reaction of state legislatures has been to apply more rigid specifics in too many areas. The situation has been well stated by John E. Nichols, former Supervisor of School Buildings and Plans in the Connecticut State Department of Education:

It must be admitted at the very outset that regulations are a practical necessity. They are essential to furnish some degree of protection against ignorance, stupidity, and unscrupulousness. In most situations they are not needed. The vast majority of architects and building committeemen want to do a job which will reflect credit upon themselves. But regulations must be established for the few who are too lazy or too stupid to inform themselves on the problems they face, or who are willing to sell out for personal gain. In a very real sense they may be a sustaining wall at the back of the official who is charged with the responsibility for protecting the interests of the public and the children. On the other hand, specific regulations may well offer the public protection from the overzealousness of that same official when sometimes he loses perspective in the pursuit of his specialty.

Despite the necessity of the regulatory code, its weaknesses and shortcomings as a type are manifold indeed.¹

It seems clear then that the minimum obligation of the state is to specify a kind of construction that will make school buildings safe for all time and under all conditions of use. Few people would deny that regulations should extend to prudential considerations of all construction factors affecting safety, health, and sanitation to protect the community against incompetence, indifference, and ignorance.

¹John E. Nichols, "School Building Codes," American School and University, p. 32. 1944.

BIBLIOGRAPHY

General References on Schoolhouse Construction

- Barrows, Alice. Functional Planning of Elementary School Buildings. United States Office of Education. Bulletin, No. 19. Washington: Government Printing Office, 1936. Pp. viii + 83.
- Engelhardt, N. L. Elementary School Building Score Card and Survey Manual. New York: Bureau of Publications, Teachers College, Columbia University, 1936. Pp. 44.
- Engelhardt, N. L. Standards for Junior High School Buildings. New York: Bureau of Publications, Teachers College, Columbia University, 1932. Pp. vi + 159.
- Hart, F. W. A Standard State Schoolhousing Code. Albany, New York: C. F. Williams and Son, 1924. Pp. 172.
- Holy, T. C. and Arnold, W. C. Standards for the Evaluation of School Buildings. Columbus, Ohio: Ohio State University, 1936. Pp. vii + 79.
- Luckiesh, Matthew. Lighting, Vision and Seeing. New York: D. Van Nostrand Company, 1944. Pp. 323.
- McGowan, Howard M. "An Analysis of State School Building Codes of the United States." Unpublished Master's thesis, Department of Education, Ohio State University, 1929.
- National Council on Schoolhouse Construction. Proceedings. Nashville, Tennessee: George Peabody College, 1934 to 1942.
- National Education Association. Report of the Committee on Schoolhouse Planning and Construction. Washington: National Education Association, 1925. Pp. 164.
- National Society for the Study of Education. The Planning and Construction of School Buildings. Part I, 33rd Yearbook. Bloomington, Illinois: Public School Publishing Co., 1934. Pp. xi + 333.
- Pruett, Haskell. School Plant Requirements for Standardized Elementary and Accredited High Schools. Nashville, Tennessee: George Peabody College for Teachers, 1934. Pp. xxii + 202.
- Sahlstrom, John W. Some Code Controls of School Building Construction in American Cities. New York: Bureau of Publications, Teachers College, Columbia University, 1933. Pp. viii + 153.
- Sexton, R. W. Schools. New York: Architectural Book Publishing Co., 1939. Pp. iv + 96.
- Sohl, Charles Edwin. State Control of the Location, Planning and Erection of Public School Buildings. Philadelphia: University of Pennsylvania, 1935. Pp. 373.

- Stoneman, Merle A. and Broady, Knute O. Building Standards for Small Schools. Lincoln, Nebraska: Teachers College and University Extension Division, University of Nebraska, 1939. Pp. xii + 183.
- Strayer, George D. and Engelhardt, N. L. Standards for Elementary School Buildings. New York: Bureau of Publications, Teachers College, Columbia University, 1923. Pp. v + 181.
- Strayer, George D. and Engelhardt, N. L. Standards for High School Buildings. New York: Bureau of Publications, Teachers College, Columbia University, 1924. Pp. 95.

Articles and Reports

- Brown, Leland H. "Planning Schools with a View to High Level Daylight Illumination in Every Classroom," American School and University, 1942, pp. 57-61.
- Bursch, Charles and Gibson, Charles D. "Daylighting the School Plant," American School and University, 1945, pp. 72-77.
- Darley, William G. "Seeing in the Schoolhouse," American School Board Journal, Vol. 111 (August, 1945), 29-32.
- Darley, William G. "Seeing in the Schoolhouse," American School Board Journal, Vol. 111 (September, 1945), 39-45.
- Engle, William O. "School Lighting," Review of Educational Research, XII (April, 1942), 211-20.
- Engelhardt, Nicholas L. "The Impact of the War Upon School Building Planning," American School and University, 1942, pp. 13-20.
- Fluorescent Lighting. Report prepared by the Consumers Union. Vol. VI (January, 1941). New York. Pp. 15.
- Gibson, Charles D. "School Plant Lighting," Review of Educational Research, XV (February, 1945), 41-50.
- Graff, Orin B. "Planning Schoolgrounds to Serve the Entire Community," American School and University, 1945, pp. 58-65.
- Graham, James L. "The Functions and Work of the National Council on Schoolhouse Construction," American School and University, 1945, pp. 23-25.
- Hacker, Ralph E. "New Material for Post War Educational Buildings," American School and University, 1944, pp. 60-65.
- Higgins, Thomas J. "Mechanical Equipment for the School," Architectural Record, Vol. 95 (March, 1944), 89-90.
- Kimball, Warren Y. "Prevention of School Fires," American School and University, 1944, pp. 25-30.
- Lewis, Samuel R. "Fifty Years in Heating and Ventilating," American School and University, 1944, pp. 228-31.
- McGrath, D. E. "Heating and Ventilating of the Post War School," American School Board Journal, Vol. 106 (January, 1943), 20.
- Nelbach, Philip E. "Modern Performance Standards for School Heating and Ventilating," American School Board Journal, Vol. 112 (January, 1946), 37-39.

- Nichols, John E. "School Building Codes," American School and University, 1944, pp. 31-35.
- Noffsinger, F. R. "A Century of Progress in Schoolroom Lighting," American School Board Journal, Vol. 96 (April, 1938), 41-42.
- Perkins, Lawrence B. "New Vs. Old Building Standards," American School and University, 1944, pp. 25-30.
- Schmidt, Hans W. "Art of Heating and Ventilating," Nations Schools, 25 (June, 1940), 34-39.
- Schmidt, Hans W. "Let's Learn More about Ventilating," Nations Schools, 26 (October, 1926), 62-64.
- Seagers, Paul W. "Heating and Ventilating the School Building," Review of Educational Research, Vol. XV (February, 1945), 51-53.
- Wright, Henry L. "Intelligent Planning of Classroom Lighting for One-Story Buildings," American School and University, 1942, pp. 184-87.

Publications of State Agencies

- Alabama State Department of Education. "Minimum Requirements and Standards for School Buildings." Montgomery, Alabama. Pp. 9 (typed).
- Arizona State Department of Public Instruction. School Laws of Arizona. Phoenix, Arizona: 1941. Pp. 204.
- Arkansas State Department of Education. "Specifications for a Standard School Building." Little Rock, Arkansas. Pp. 23 (mimeographed).
- California Department of Public Works, Division of Architecture. Rules and Regulations Relating to the Safety of Design and Construction of Public School Buildings. Sacramento, California: 1942. Pp. 53.
- Colorado State Department of Education. School Laws of the State of Colorado. Denver, Colorado: 1941. Pp. viii + 358.
- Connecticut State Department of Education. School Building Code. Hartford, Connecticut: 1941. Pp. 127.
- Delaware State Department of Public Instruction. Minimum Standards for School Buildings and Sites. Dover, Delaware: 1931. Pp. 31.
- Florida State Department of Education. Florida School Laws. Tallahassee, Florida: 1939. Pp. xxiv + 455.
- Florida State Department of Education. Florida School Laws, 1941 Supplement. Tallahassee, Florida: 1941. Pp. vi + 72.
- Idaho State Department of Education. "School Building Regulations for Idaho." Boise, Idaho: 1940. Pp. 9 (mimeographed).
- Illinois State Department of Public Safety, Division of Fire Prevention. Fire Escapes. Springfield, Illinois: 1929. Pp. 35.
- Illinois State Department of Public Safety, Division of Fire Prevention. Fire Laws of Illinois. Springfield, Illinois. Pp. 18.

- Illinois State Department of Public Safety, Division of Fire Prevention. Fire Safety Requirements for Schoolhouses. Springfield, Illinois. Pp. 8.
- Indiana State Department of Education. School Laws of the State of Indiana. Indianapolis, Indiana: 1939. Pp. 533.
- Indiana State Department of Education. School Laws Enacted by the 1941 Indiana General Assembly. Indianapolis, Indiana: 1941. Pp. 30.
- Kansas State Department of Public Instruction. Kansas School Laws. Topeka, Kansas: 1939. Pp. 352.
- Kansas State Department of Public Instruction. School Legislation Regular Session 1943. Topeka, Kansas: 1943. Pp. 62.
- Kentucky State Department of Education. Planning and Financing School Buildings and Grounds. Vol. XI, No. 4. Frankfort, Kentucky: 1943. Pp. 202-204.
- Maine State Department of Education. Laws and Rulings of Commissioner of Education and Minimum Requirements for Approval of Buildings. Augusta, Maine: 1941. Pp. 11.
- Maryland State Department of Education. "Standards for Maryland School Buildings." Baltimore, Maryland: 1941 (revised). Pp. 21.
- Massachusetts Department of Public Safety, Division of Inspection. Regulations Relative to the Inspection of Buildings Which Are Subject to the Provisions of Chapter 143, General Laws. Boston, Massachusetts: (form B-1). Pp. 25.
- Massachusetts State Department of Public Safety. Laws Relating to the Erection, Alteration, Inspection and Use of Buildings. Boston, Massachusetts: (form A). Pp. 19.
- Michigan State Department of Public Instruction. "Michigan School Building Law." Lansing, Michigan: 1941. Pp. 3 (mimeographed).
- Michigan State Department of Health. "Sanitation Standards for Schools." Lansing, Michigan: 1942. Pp. 8 (mimeographed).
- Missouri State Department of Public Schools. Missouri School Laws. Jefferson City, Missouri: 1942. Pp. vi + 294.
- Montana State Department of Public Instruction. School Laws of the State of Montana. Helena, Montana: 1941. Pp. 238.
- Nebraska State Department of Education. Letter from Wayne O. Reed, Superintendent of Public Instruction; Lincoln, Nebraska: October 29, 1943.
- New Jersey State Department of Public Instruction. Building Code Concerning Public School Buildings. Trenton, New Jersey: 1925 (revised and supplement of 1936). Pp. 42.
- New Mexico State Department of Education. New Mexico Public School Code. Santa Fe, New Mexico: 1938. Pp. 128.
- New Mexico State Department of Education. 1941 Supplement to Public School Code. Santa Fe, New Mexico: 1941. Pp. 78.

- New York State Education Department. "Requirements for the Plans and Specifications for the Erection, Repair, Enlargement and Remodeling of School Buildings." Albany, New York. Pp. 4 (mimeographed).
- North Dakota State Department of Public Instruction. General School Laws. Bismark, North Dakota: 1935. Pp. 275.
- Ohio State Department of Industrial Relations, Division of Factory and Building Inspection. School Buildings. Bulletin of Division of Factory and Building Inspection, No. 103. Columbus, Ohio: 1940. Pp. 22.
- Oklahoma State Department of Education. School Laws of Oklahoma. Oklahoma City, Oklahoma: 1941. Pp. 210.
- Pennsylvania State Department of Public Instruction. The School Plant. Bulletin 86. Harrisburg, Pennsylvania: 1939. Pp. 51.
- South Carolina State Department of Education. School Laws of South Carolina. Columbia, South Carolina: 1942. Pp. 447.
- South Dakota State Department of Public Instruction. The School Laws of the State of South Dakota. Pierre, South Dakota: 1943. Pp. xi + 247.
- Texas State Department of Education. Public School Laws of the State of Texas. Austin, Texas: 1941. Pp. 292.
- Vermont State Department of Public Health. Rules and Regulations Relating to Public Buildings, Fire Escapes and Plumbing. Montpelier, Vermont: 1925. Pp. 16.
- Vermont State Fire Marshall. Vermont Laws and Regulations Relating to Fire Escapes and Exits for Public Buildings. Montpelier, Vermont: 1937. Pp. 6.
- Virginia State Department of Education. Regulations of the State Board of Education. Bulletin of the State Board of Education, "Vol. xix," No. 4. Richmond, Virginia: January, 1937. and supplement of November, 1941. Pp. 31.
- West Virginia State Department of Education. "Standards for School Building Construction." Charleston, West Virginia: Pp. 4 (mimeographed).
- Wisconsin State Industrial Commission. Wisconsin State Building Code. Madison, Wisconsin: Bureau of Purchases, 1942. Pp. 173.
- Wisconsin State Industrial Commission. Heating, Ventilating, and Air Conditioning Code. Madison, Wisconsin: 1936. Pp. 48.
- Wisconsin State Industrial Commission. School Lighting Code. Madison, Wisconsin: 1944. Pp. 31.

General Building Codes and Standards

- American Society for Testing Materials. Fire Tests of Building Construction and Materials. Philadelphia, Pennsylvania: 1941. Pp. 5.
- American Society for Testing Materials. Fire Tests for Door Assemblies. Philadelphia, Pennsylvania: 1941. Pp. 5.

- National Board of Fire Underwriters. Building Code. New York City: 1943 Edition. Pp. ix + 406.
- National Fire Protection Association. Building Exits Code. "Seventh Edition, 1942." Boston, Massachusetts: 1943. Pp. 109.
- Pacific Coast Building Officials Conference. Uniform Building Code. "1943 Edition," Los Angeles, California: 1944. Pp. 322.

